WIRE

JULY, 19

AND WIRE PRODUCTS

-and VAUGHN®

Double
-Cooling

yanked the heat
out *FAST*

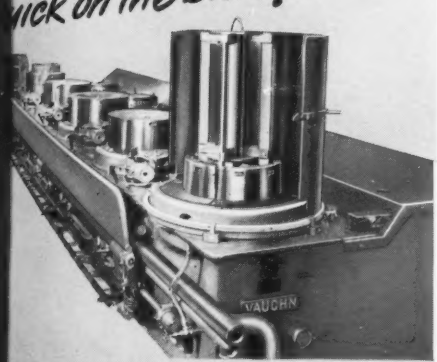
WITHOUT
SOAKING ACTION

Yes, you can run up really big bundles on Vaughn Motoblox—safely, speedily, with the wire in perfect condition thanks to Vaughn Double-Cooling! Air blast and water jets *combined* do a dual cooling job, yanking heat away before the wire is affected. No storage means no heat-soak, either! *Get the facts from Vaughn.*

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO, U.S.A.

COMPLETE COLD DRAWING EQUIPMENT .... Continuous or Single Hole ... for the Largest Bars and Tubes ... for the Smallest Wire ... Ferrous, Non-Ferrous Materials or their Alloys.

ick on the Draw!"



5/6 HRM Motoblox® with Front Safety Guard and Finishing Block Guard in open position.

FFICIAL PUBLICATION OF THE WIRE ASSOCIATION

COULTER & McKENZIE

continuous

WIRE DRAWING & PACKAGING MACHINE

PRECISION BUILT CUSTOM ENGINEERED

SUPER FAST BLOCK CHANGES — Push-button control interchanges 3 standard size draw blocks in seconds with **no gear or belt changes.** (8″, 10″ and 12″ blocks)

EXTRA VERSATILE PACKAGING — Accommodates coils, stems, and Draw-Pak containers. (20″ x 30″ or 23″ x 30″ drum)

MODEL NO. 116-B

IMPROVED DESIGN FEATURES:

1. Positive tangle switch
2. Fully enclosed
3. Liquid cooled
4. All steel welded construction
5. Electric clutch for "Soft Starting"

GREATER PRODUCTION CAPACITY

1. Continuous drawing and packaging of ferrous or non-ferrous wires.
2. Wire sizes to .100″
3. Number of reductions — 3 to 12
4. Speeds to 1000 ft./min.

For information concerning your application, please write or telephone.

Model 116-B will be custom engineered to your particul

This equipment manufactured under one of the following U. S. Patents 2,732,060; 2,868,474; 2,844,416; 2,868,268 or others pending.

Barron & Crowther Ltd., Eastleigh, England. European Draw-Pak Licens Idos Industries Ltd., Royston, England, Sales Agents.

35 UNION AVENUE

TELEPHONE EDISON 5-1101
LIEBER'S CODE "MACKENZIE"

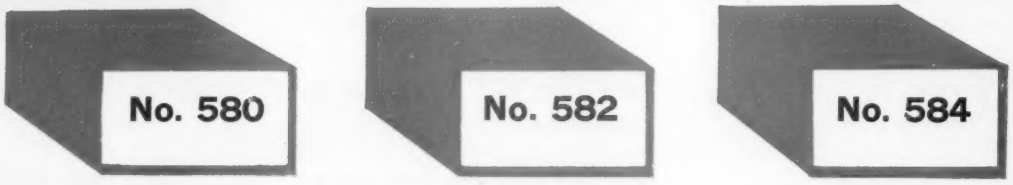
THE COULTER & McKENZIE MACHINE CO., INC.

SINCE 1843 BRIDGEPORT 7, CONNECTICUT, U.S.A. INCORPORATED 1881

PRESENTING
THE "580" GROUP . . .

A New Series of "Full Range Lubricants"

"America's Finest Wire Draw"



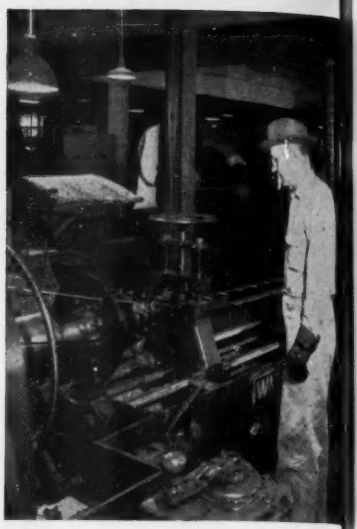
1. **Designed for practical application in any mill as a General Purpose Lubricant.**
2. **Now in daily use as a Spring and Rope Wire Lubricant.**
3. **Designed to permit substantial "leaning," to meet specific in-plant and customer requirements.**
4. **Mill Tested and Approved for both High and Low Carbon Steel and numerous Ferrous and Non-Ferrous Alloys.**
5. **Our field service representatives are available to review this entire series at your convenience.**

"Look to Standard for the Future"

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

Cordially yours,

Standard Industrial
COMPOUNDS CO., INC.
Member WAS
FRANKFORT, ILLINOIS
(A suburban Chicago area city)
Telephones: 2131 - 2141



Youngstown Rope Wire
passes through preforming head and closing die, to become Broderick & Bascom's famous "Yellow Strand" wire rope.

Accent on Excellence

Youngstown rope wire

Lifting a mighty fir or a stalled automobile, a sling of wire rope is tough to beat for speed, safety and handling ease. Long experience, sound engineering and only the best materials—that's what it takes to make a good sling, and Broderick & Bascom makes them for almost every lifting job you can name.

This leading maker of slings and wire rope never compromises with quality. They count on Youngstown Rope Wire to uphold their reputation—*and it does.* Broderick & Bascom "Yellow Strand", and extra high-strength "POWERSTEEL" wire rope are made of Youngstown Rope Wire that consistently meets the most exacting quality standards.

Wherever steel becomes a part of things *you* make, the high standards of Youngstown *quality*, the personal touch in Youngstown *service* will help you create products with an "accent on excellence".
The Youngstown Sheet and Tube Company, Youngstown, Ohio.
Carbon, Alloy and Yoloy Steel.

Youngstown

QUALITY YOUNGSTOWN SERVICE

VYGEN® special PVC compounds and resin

FOR WIRE AND CABLE COATING

In addition to Vygen 120 PVC resin, there are *three* specially-formulated Vygen compounds completely tested and UL-approved for specific wire and cable applications. Available in quantities to fit your needs, each Vygen compound and resin is composed of the very finest raw materials, processed in the most modern facilities. Each is designed to do its job better, *and* to save you money. Send for generous samples, literature and technical assistance.

VYGEN 6812 COMPOUND

UL-approved for UF-NMC cable, Type T, TW, 60°C, Oil, and 80°C appliance wire applications. May also be used as primary insulation for other cable constructions and jacketing.

VYGEN 6035 COMPOUND

UL-approved for Type T, TW, and exposure to oil use at 60°C. This compound combines excellent physical and electrical properties with very good weather and flame resistance.

VYGEN 9221 COMPOUND

Meets UL requirements for 90 and 105°C applications. Recommended for appliance, radio hook-up, machinery wire etc. where heat resistance and good physical properties are required.

VYGEN 120 RESIN

UL-approved as interchangeable with other PVC resins used as wire insulating material. For fast dry-blend extruding with monomeric or polymeric plasticizers—assures lack of gelled particles, excellent heat and light stability and long life.

TYPICAL ANALYSIS

Form	White Powder
Intrinsic Viscosity	1.18
Specific Gravity	1.40
Bulk Density, gm/cc	0.52
lbs/ft³	32.5
Volatiles	0.2

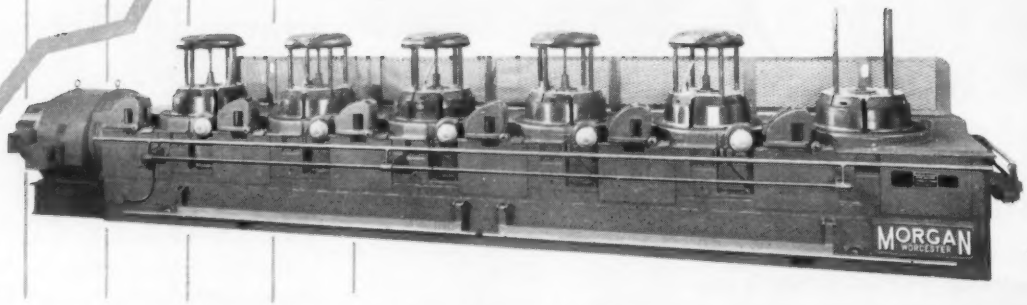
Creating Progress Through Chemistry

PHYSICAL PROPERTIES OF MOLDED SPECIMENS

	6812	6035	9221
Specific Gravity at 25°C/4°C	1.32	1.33	1.38
Tensile, psi at 25°C	2550	2950	3100
Modulus at 100% Elongation, psi	1450	1780	2150
Elongation, % at 25°C	320	315	340
Hardness, Shore A, inst at 25°C 10 sec at 25°C	90 82	94 86	97 92
Brittle Point, at – 15°C	Passes	Passes	Passes
Volume Resistivity, ohm-cm at 25°C and 50% R. H.	3.1×10^{14}	2.8×10^{14}	3.5×10^{13}

Chemical Division GENERAL
THE GENERAL TIRE & RUBBER CO.
VYGEN

INCREASE PRODUCTION



with IMPROVED MORGAN-CONNOR Wire Machines

Morgan-Connor offers you a wide range of wire drawing machines of proven efficiency—with up-to-the-minute refinements. You can produce heavy-weight bundles—fast—and with low power and low die cost.

MORGAN CONSTRUCTION CO.
WM-114
WORCESTER, MASSACHUSETTS, U. S. A.

ROLLING MILLS | MORGOIL BEARINGS • WIRE DRAWING MACHINES • COMBUSTION CONTROLS

WIRE AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 34 July, 1959 No. 7

Designated as Official Publication By The Wire Association

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YOU NEVER KNOW
THE COST
OF A TOOL UNTIL
YOU HAVE TO
REPLACE IT!

UNLIKE SOME TOOLS
CAREW
CUTTING NIPPERS

don't have 1000 uses. They are made only for cutting wire.

CAREW NIPPERS will continue to do this year after year; cutting efficiently long after most tools have been junked.

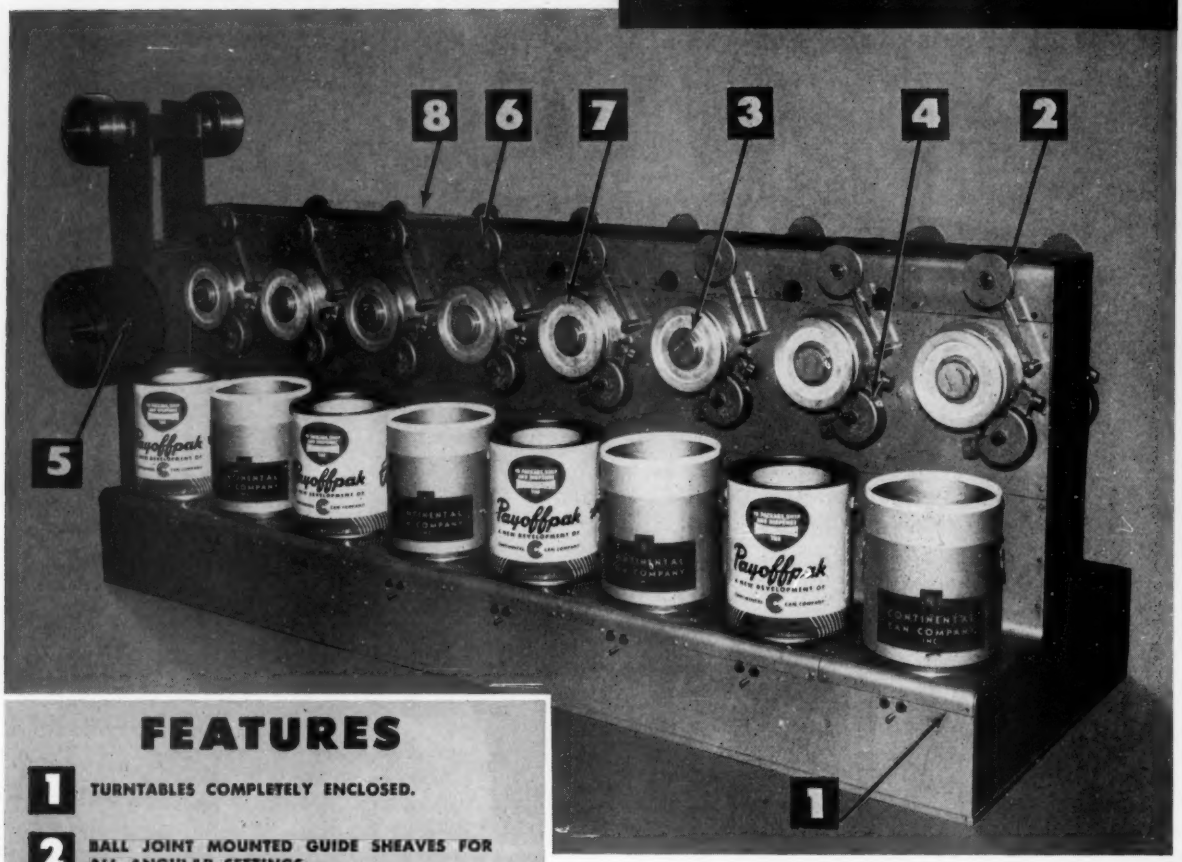
MADE IN 4 SIZES
8", 10", 12", 14"

Jaws are made of hardened tool steel and are removable for sharpening.

STOCKED BY MOST MILL SUPPLY DEALERS

Made by
M. W. ROBINSON
COMPANY, INC.
ROCKFALL, CONNECTICUT

ANNOUNCING the WYREPAK



FEATURES

1. TURNTABLES COMPLETELY ENCLOSED.
2. BALL JOINT MOUNTED GUIDE SHEAVES FOR ALL ANGULAR SETTINGS.
3. ELECTRO-MECHANICAL TENSION CONTROL FOR EACH HEAD.
4. PRECISION GROUND PRESSURE ROLLS.
5. PRIME RUBBER LAGGED CAPSTAN.
6. ASSEMBLED AND ALL ADJUSTMENTS MADE WITH ALLEN SCREWS.
7. ALUMINUM CAPSTANS, WITH HARD-ANODIZED, POLISHED RUNNING SURFACES.
8. INDIVIDUAL MAINTENANCE ON EACH SECTION.

The drum packaging Take-Up System illustrated, Model S5-TC-S, was designed especially for Magnet Wire.

Other models are made for all types of ferrous and non-ferrous wires.

Advanced engineering and precision construction have evolved in this machine new concepts of speed and efficiency in the packaging of wire. Capacity: Min. size — #32 ga.; max. size — #20 ga. wire.

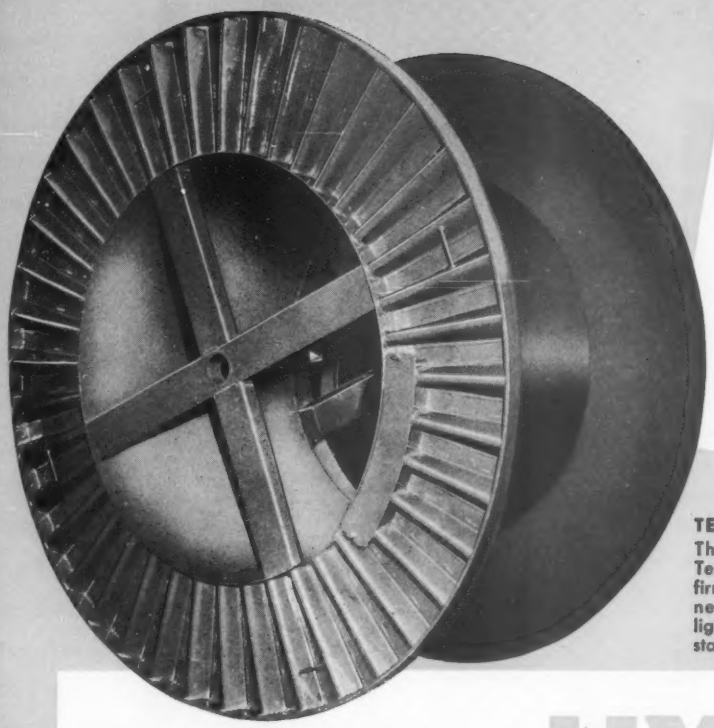
YOU ARE INVITED TO SECURE COMPLETE DETAILS REGARDING THIS ADVANCED PROCESS FROM —

Advanced Wyrepak Co., Inc.

11 HARRISON COURT PHONE: EDison 4-4274 BRIDGEPORT, CONN.

OR The Vaughn Machinery Co., CUYAHOGA FALLS, OHIO

Proven By Actual Test!



NEW YORK TESTING LABORATORIES, INC.
CHEMICAL, ELECTRICAL, METALLURGICAL AND MECHANICAL Engineers
TELEPHONE: BOWLING GREEN 9-8280-9
47 WEST STREET
NEW YORK 6, N. Y.

March 9, 1959

New York Engineering Company
75 West Street
New York 6, N. Y.

Gentlemen:

We have tested your "NYECO" Light Weight Steel Reel, 78" x 48" x 36" traverse, Drawing Number 51015, and offer the following comment with reference to our Test Report:

ASSUMING A CONSERVATIVE SAFETY FACTOR OF 2 BASED UPON YIELD STRENGTH, IT IS OUR OPINION THAT THE CABLE REEL CAN BE SAFELY LOADED TO 16,650 LBS. WITHOUT DISTORTION.

Very truly yours,
NEW YORK TESTING LABORATORIES, INC.

RH:awk

Roger Harvey
Managing Director

ANALYSIS—INSPECTIONS—LITIGATIONS—SURVEYS AND TESTS ON ALL MATERIALS, PROCESSES AND PRODUCTS

TESTED AND APPROVED!
This letter from New York Testing Laboratories, Inc. confirms the superiority of the new NYECO smooth-faced, light weight steel reel over standard reels.

ANNOUNCING THE NEW NYECO

SMOOTH-FACED LIGHT WEIGHT STEEL REEL

NOW AVAILABLE FROM NYECO . . .

greater protection against damage in shipping and processing with this rugged, weather-resistant, warp-proof, NYECO Steel Shipping Reel. All reels are furnished with four cross-arms unless otherwise specified. Drive-holes optional. No die charges or extras . . . any drum diameters or traverse. Flange diameters 42" to 90" inclusive.

NYECO ALSO MANUFACTURES

- Impregnating Tanks
- Vulcanizers
- Floor Rolls
- Pressure Vessels

YOUR INQUIRIES WILL RECEIVE OUR PROMPT ATTENTION

Send specifications for STEEL SHIPPING REELS, IMPREGNATING REELS, PROCESSING REELS, SUBMARINE CABLE REELS AND BRIDGE REELS. Prompt deliveries on large or small orders.

ANY QUANTITY—ANY SIZE—
ANY LOAD FLANGE DIAMETER
from 42" up

Specialists to the wire industries for over 50 years.

NYECO

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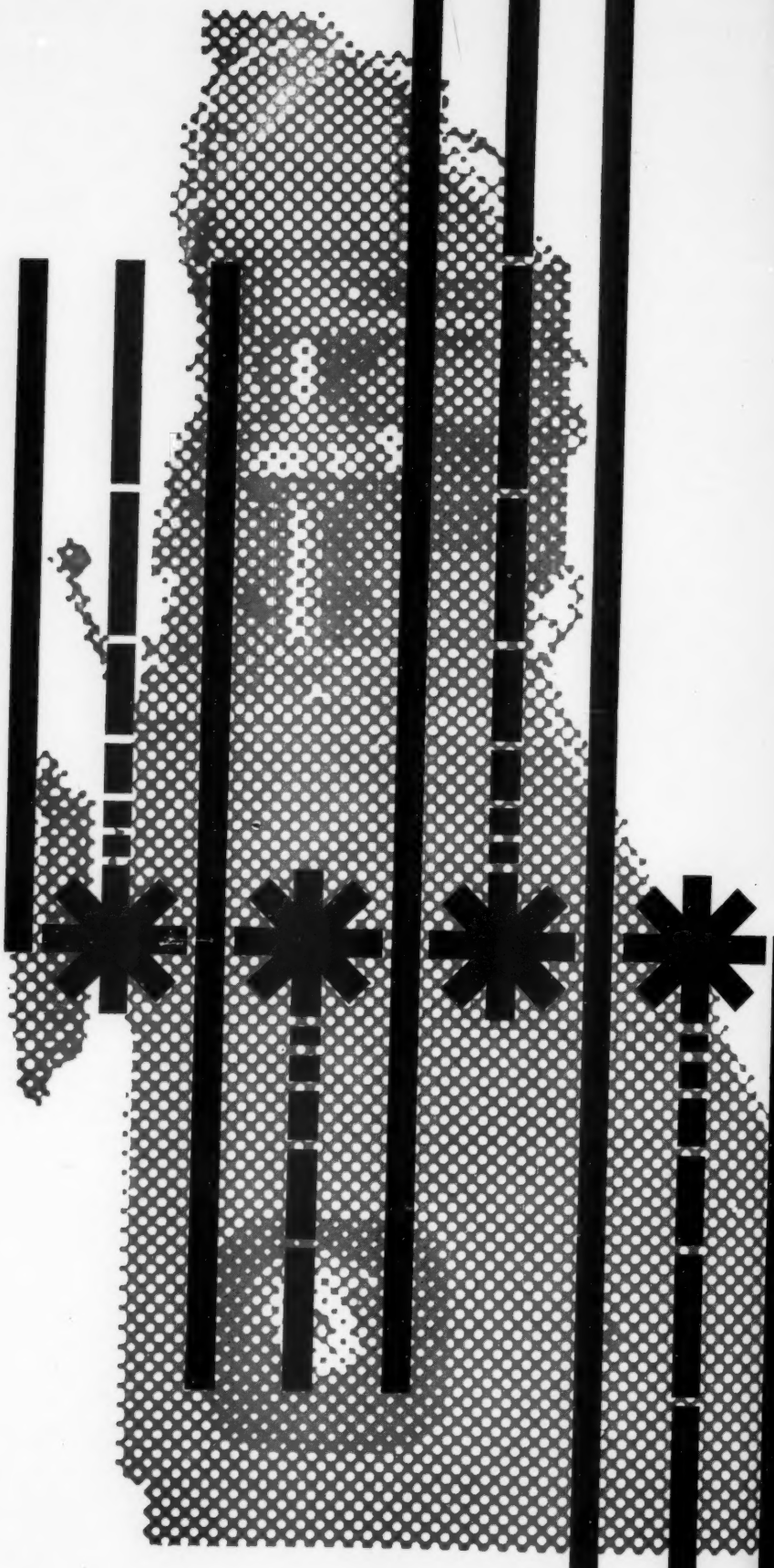
TELEPHONE: WHitehall 4-5380 • CABLE: NYECO, N. Y. • PLANTS: YONKERS, N. Y.

EXCITEMENT



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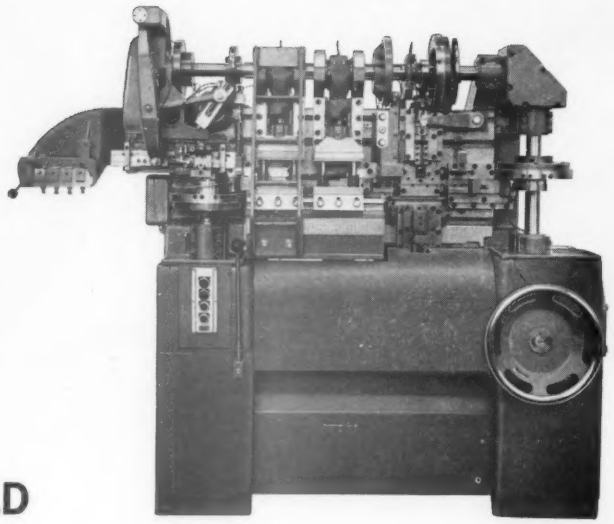
Torringt

Once in a blue moon, a really exciting new production machine is developed . . . and this is it!

It's the Torrington **Verti-Slide** which promises a genuine revolution in the production of just about everything in strip forming that is now being produced by progressively tooled presses.

Single-handed, the Torrington **Verti-Slide** has already demonstrated its ability to replace as many as six presses in high speed precision production of complex parts.

Cooler heads than ours are telling **us** that it's the most exciting new development in its field in half a century.



IN THE PRODUCTION WORLD

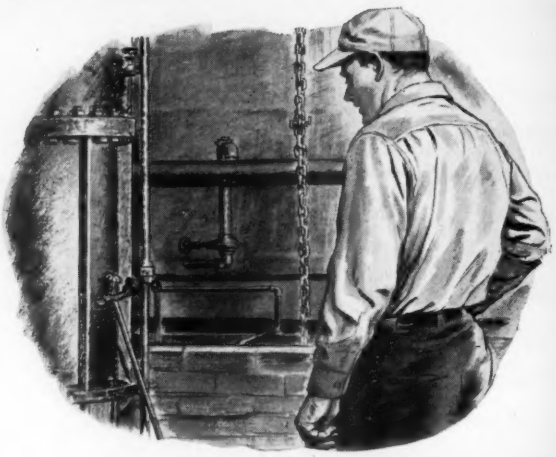
Write or call today for complete data—or a Torrington sales engineer.

THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT · VAN NUYS, CALIFORNIA · OAKVILLE, ONTARIO

new, cost-reducing chemical for ACID PICKLING BATHS

AMCHEM SERSEAL* reduces heating requirements up to 70%, improves working conditions!

BEFORE SERSEAL, steam vapors and fumes escape from the bath, making working conditions unpleasant, lowering morale.



SERSEAL HAS BLANKETED THE BATH in just 10 seconds. All steam, corrosive fumes and vapors are contained within bath.

Put these 7 important Serseal advantages to work for you!...

1 Save up to 70% in heating costs.

2 Improve working conditions both from a comfort and health standpoint. Steam, heat, fumes and vapors are contained within the bath.

3 Cut warmup time. The blanket prevents heat loss.

4 Less corrosion of surrounding equipment. Corrosive fumes are retained in the bath.

5 Reduce the cost for heating elements.

6 Less exhaust equipment required. Since the bath is sealed, there is little escape of fumes and vapors. And in many cases, ventilating systems can be safely eliminated.

7 Now proving its economy, efficiency and overall satisfaction in many customer plants.

Write today for complete information about this important new cost-reducing, work-saving chemical blanket for acid pickling baths! Address Ambler 50, Pa.

AMCHEM

*Patent applied for **SERSEAL**

Amchem Serseal is another chemical development of **Amchem Products, Inc.** (Formerly American Chemical Paint Co.) AMBLER 31, PA. • Detroit, Mich. • St. Joseph, Mo. • Niles, Calif. • Windsor, Ont. • Amchem is a registered trademark of Amchem Products, Inc.

The man who works with aluminum thinks of...

MEMO

nichols
NEVER-STAIN
ALUMINUM®

Get shop prints from W. L.

New Product Designs

Pick up Susie's Doll

Rotary Club Lunch with prod. mgr.

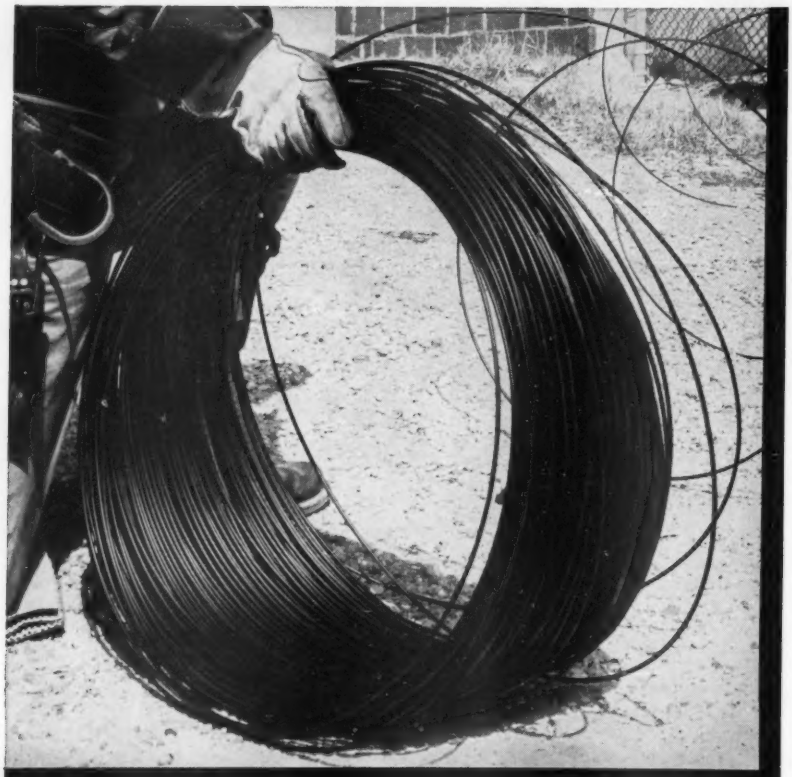
A120 (OH) 4

DOCKET THIS ITEM FOR ISD. MTG.

Maintenance Factor

NICHOLS WIRE & ALUMINUM CO., DAVENPORT, IOWA

hi-fax® The new name in wire and cable, pre-sold to your customers



- *A Quality Plastic*
- *Economical to use*
- *Actively Promoted*

If your customers haven't already asked you about wire and cable made from Hi-fax they probably will in the near future. That's because Hi-fax (Hercules high density polyethylene) is the new name in plastics . . . a material with superior advantages over conventional insulations.

In addition, an active advertising and promotion campaign has been bringing Hi-fax to the attention of the key buying influences in the wire and cable field. Trade advertising, direct mail, technical literature—all have been coordinated in an effort to focus attention on this new material.

If you have missed the advertising messages directed toward your customers or are not completely familiar with the technical aspects of this completely new plastic, we'll be glad to send you additional information. Just write to Hercules and outline your specific interests.

HOW HI-FAX COMPARES WITH OTHER INSULATIONS

	Hi-fax High Density Polyethylene	Conventional Polyethylene	Neoprene	PVC
Abrasion resistance	excellent	good	fair	good
Chemical resistance	excellent	very good	very good	very good
Cold bend	very good	very good	very good	fair
Corona resistance	fair	fair	poor	excellent
Dielectric strength	excellent	excellent	good	excellent
Environmental stress cracking	good	marginal	— — —	excellent
Flame resistance	poor	poor	very good	very good
Heat distortion temperature	good	poor	very good	good
Heat softening point	good	poor	very good	good
Insulation resistance	excellent	excellent	poor	good
Moisture resistance	excellent	excellent	fair	excellent
Oil resistance	excellent	good	excellent	good
Ozone resistance	very good	very good	good	excellent
Power factor	excellent	excellent	poor	poor
S I C	excellent	excellent	poor	fair

Hercules Powder Company does not manufacture insulated wire and cable, but supplies Hi-fax high density polyethylene in resin form to wire and cable producers.

Cellulose Products Department

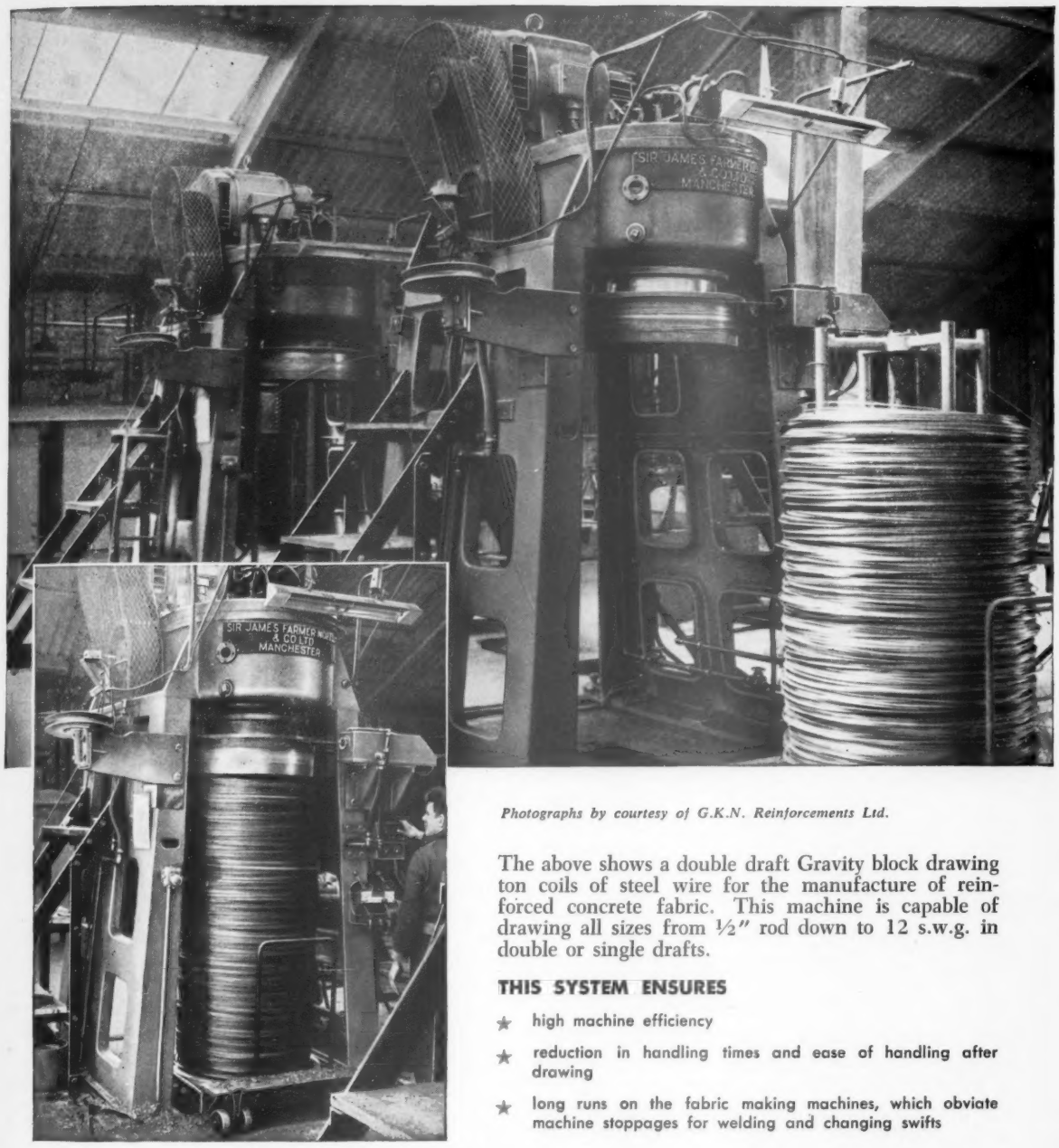
HERCULES POWDER COMPANY

INCORPORATED

900 Market Street, Wilmington 99, Delaware

CP59-9

Farmer Norton



Photographs by courtesy of G.K.N. Reinforcements Ltd.

The above shows a double draft Gravity block drawing ton coils of steel wire for the manufacture of reinforced concrete fabric. This machine is capable of drawing all sizes from ½" rod down to 12 s.w.g. in double or single drafts.

THIS SYSTEM ENSURES

- ★ high machine efficiency
- ★ reduction in handling times and ease of handling after drawing
- ★ long runs on the fabric making machines, which obviate machine stoppages for welding and changing swifts

Makers of all classes of Wire Drawing Machinery and pioneers of the inverted block system for handling large coil weights.

Sir James Farmer Norton & CO. LTD.

ADELPHI STREET • SALFORD • LANCASHIRE • ENGLAND

Sole Representative in U.S.A.: Steel & Wire Machine Co., 15457 Euclid Ave., Cleveland 12, Ohio. MUlberry 1-7151

Specify

BLACAR®

PVC Resins & Compounds

PVC RESIN—**BLACAR #250**—UL approved for complete interchangeability in recognized compounds. High molecular weight—low gel count—excellent dry blending and extrusion characteristics. Intermediate and low molecular weight resins also available.

PVC COMPOUNDS—In natural, white or black-dry blend or diced.

BLACAR #2800—UL approved for type T and TW wire—oil at 60°C—80°C appliance wire.

BLACAR #2700—UL approved, primary insulation, for type T, TW, TF, TFF wire—oil at 60°C—wide range of low-tension applications.

BLACAR #2600—UL approved for type TF and TFF wire and cable insulation.

Specialists in wire covering—Cary has a compound for every UL requirement. Our summary of recommended compounds is available on request.

Technical assistance, complete data, or working samples—available as requested.

CARY CHEMICALS INC.

CARY CHEMICALS INC.

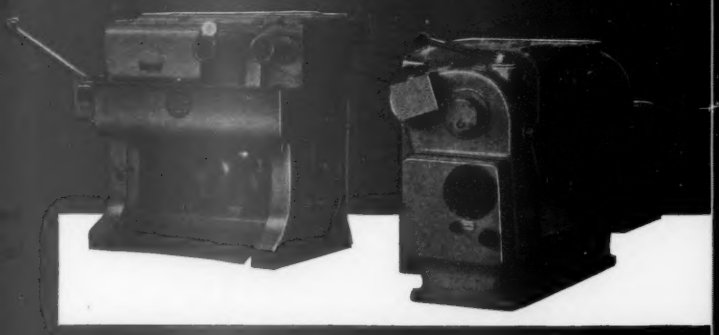
Mail address: **P.O. BOX 1128, NEW BRUNSWICK, N. J.**

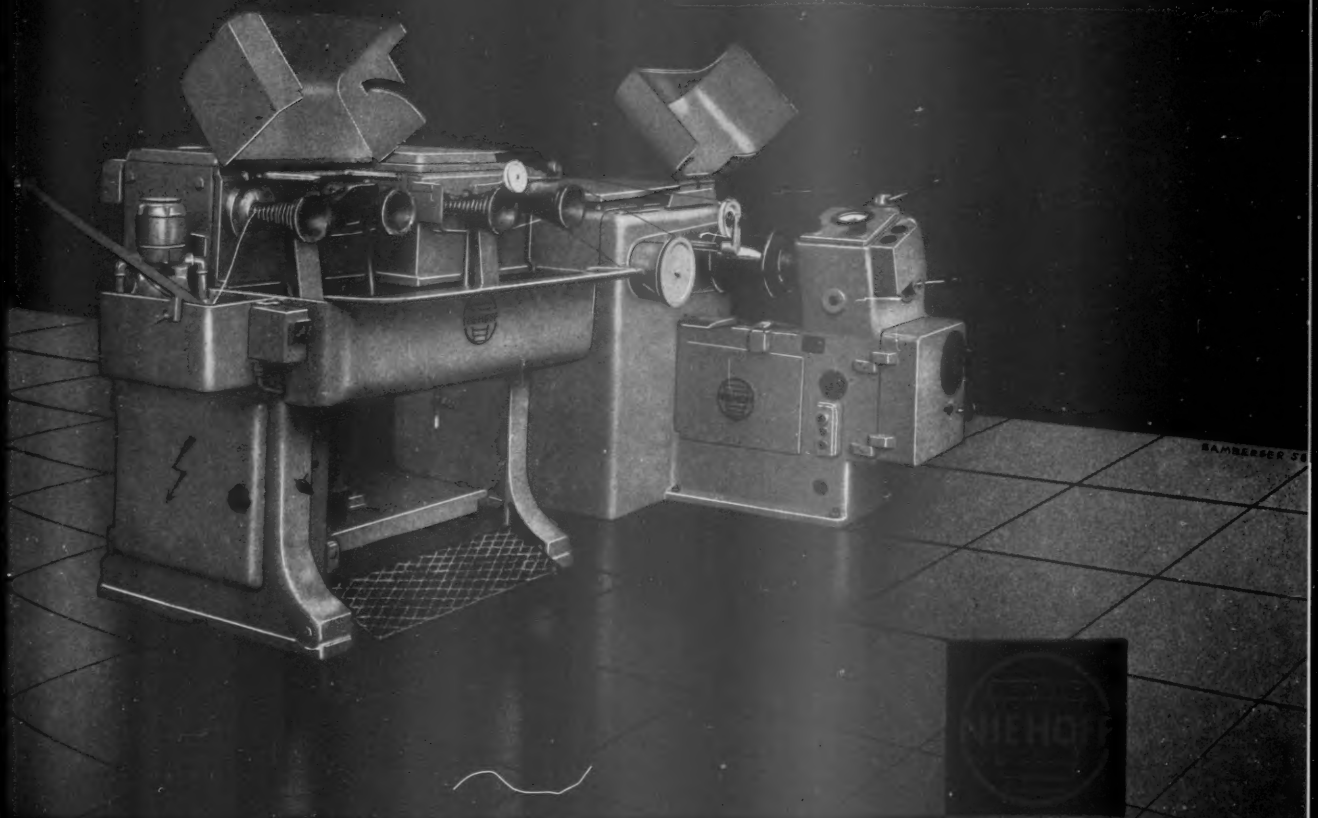
Plants at: East Brunswick and Flemington, N. J.

VINYL RESINS — VINYL COPOLYMERS — VINYL COMPOUNDS — SPECIALTY WAXES — HIGH MELTING POINT SYNTHETIC WAXES

Canadian Representative: Lewis Specialties, Ltd., 18 Westminster North, Montreal 28, Que.

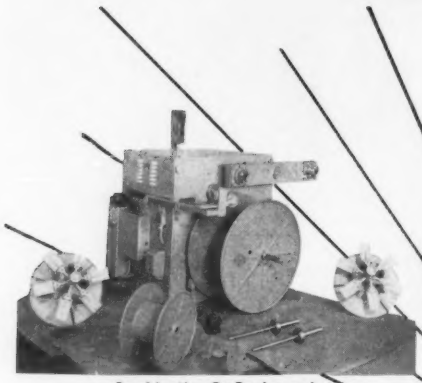
NIEHOFF WIRE DRAWING UNITS



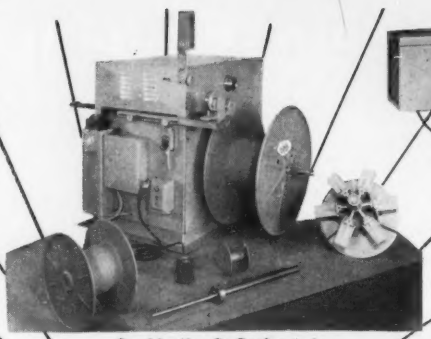


NIEHOFF MACHINE WORKS

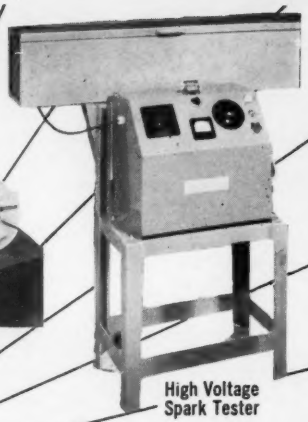
SCHWABACH NEAR NURNBERG WESTERN GERMANY



Combination Re-Reeler and
Re-Spooler with Indexing Head

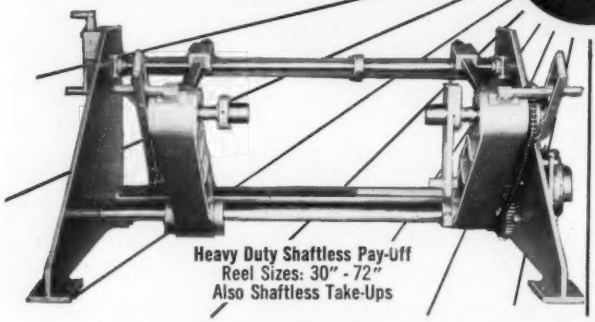


Combination Re-Reeler and
Re-Spooler with Interchangeable
Shaft Features

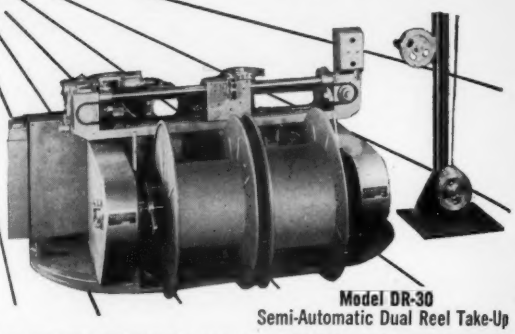


High Voltage
Spark Tester

FOR ACCURACY — DAVIS WIRE & CABLE EQUIPMENT — FOR DEPENDABILITY



Heavy Duty Shaftless Pay-Off
Reel Sizes: 30" - 72"
Also Shaftless Take-Ups



Model DR-30
Semi-Automatic Dual Reel Take-Up

THE NEWLY REDESIGNED *DAVIS WIRE & CABLE EQUIPMENT* IS BETTER THAN EVER

Modernized, streamlined and engineered for fast production of safely insulated wire and cable, the newly redesigned DAVIS ELECTRIC line of Spark Testers, Pay-Offs, Take-Ups, Counters, Spoolers, Traverses and Capstans is now offered as the finest ever conceived and produced by DAVIS ELECTRIC engineers. Before you buy, you owe it to your pocketbook as well as your business reputation to learn what this unexcelled machinery can do to better satisfy your customers (and your stockholders!). Refinements and advancement in designs qualify the 1959 DAVIS ELECTRIC line to surpass in performance previous DAVIS products in use in 80% of the industry's wire mills and some of which have been in operation for 15 years without maintenance problems!

What better tribute to quality can one ask?

Write for complete details and find out how DAVIS ELECTRIC can improve your wire and cable production and promote profit in your plant.

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WIRE & CABLE
EQUIPMENT

DAVIS ELECTRIC CO.

WALLINGFORD, CONNECTICUT

DUAL and SINGLE TAKE-UPS • PAY-OFFS • CAPSTANS
SPARK TESTERS • RE-SPOOLERS
RAM-TYPE TEFLON EXTRUDERS

WESTERN CONTROL CORP.

achieves three-way control with

KEYSTONE WIRE

At their modern plant in Wichita, Kansas, Western Control Corporation produces flexible controls that are specified for many applications from lawnmowers to giant excavators. This wide range is the result of closely controlled quality and cost at Western Control. Western has successfully used Keystone MB Spring Wire since its inception in 1946. Here are some reasons they give:

CONTROL OF PRODUCTION — Keystone metallurgists worked with Western and developed a special quality of drawn galvanized spring wire for high speed coiling. Constant uniformity of MB Spring Wire means long production runs — increased productivity of machinery.

CONTROL OF QUALITY — Company officials report, "Uniformity of temper and size of Keystone MB Spring Wire gives us close inside and outside diameter tolerances. Coating, too, is superior — no flaking or stripping in the manufacturing process."

CONTROL OF COSTS — Keystone furnishes drawn galvanized MB Spring Wire to Western in pay-off packs. This means less waste — less set up time — less handling time — and cleaner wire. To Western, this means a quality product at a competitive price.

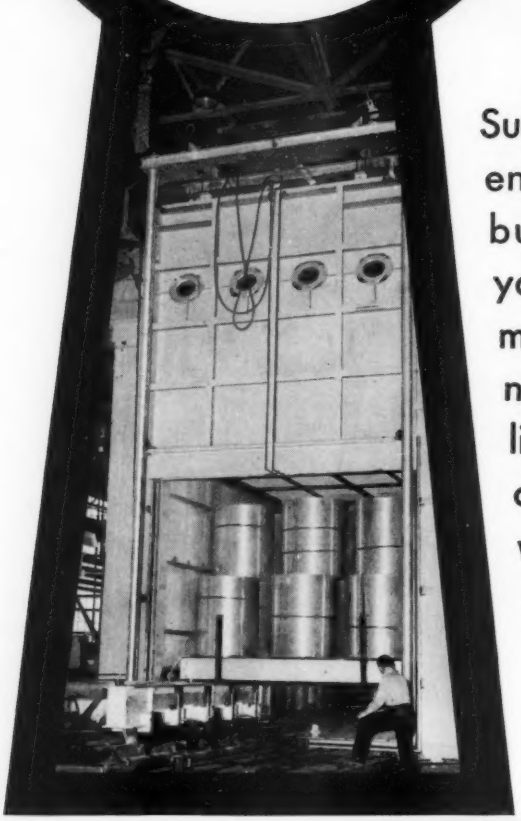
Could you benefit from our experience in solving difficult wire problems? Talk it over with your Keystone Wire Representative.

Keystone Steel & Wire Company, Peoria 7, Illinois

KEYSTONE

WIRE FOR INDUSTRY

YOUR FURNACE



SUNBEAM WILL BUILD YOUR "TURN-KEY" FURNACE EQUIPMENT FROM DESIGN TO INSTALLATION

Sunbeam will handle the entire job of designing, building and installing your next furnace equipment. And whether you need an entire furnace line... or a single piece of equipment... *it's wise to get a quote from SUNBEAM.*

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The Best Industrial Furnaces Made

SUNBEAM EQUIPMENT CORPORATION
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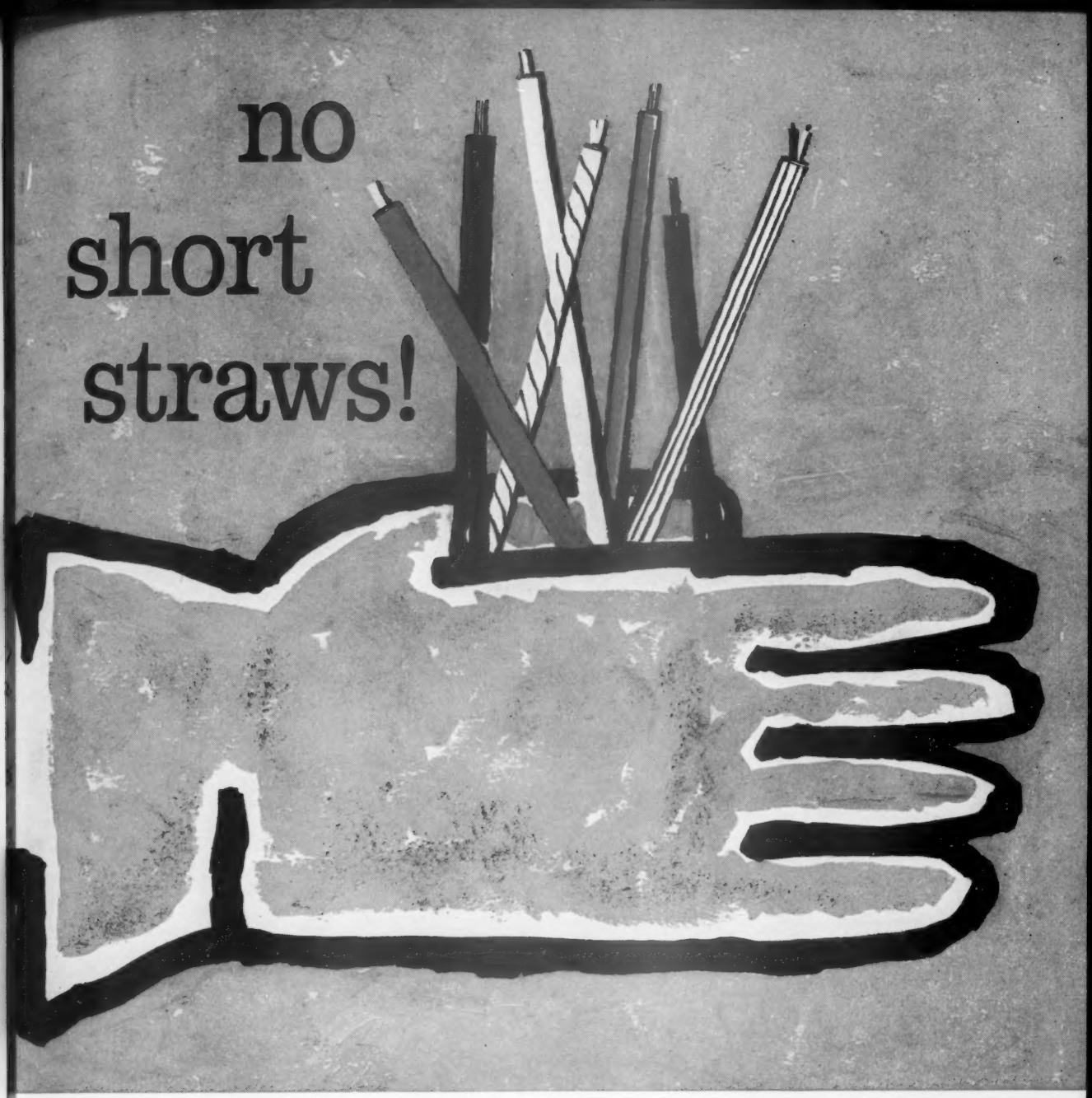


Each formula in the Monsanto expanding series of Opalon* Vinyl compounds is based on over ten years of experience in supplying the specialized needs of the Wire and Cable Industry. That's why you can always count on a correct answer to your specific insulation problem.
Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.

Monsanto

*OPALON: REG. U. S. PAT. OFF.

OPALON 1217—OPALON 1218 Inside distribution cable jacketing compounds, with toughness, ease of extrusion, excellent service life.

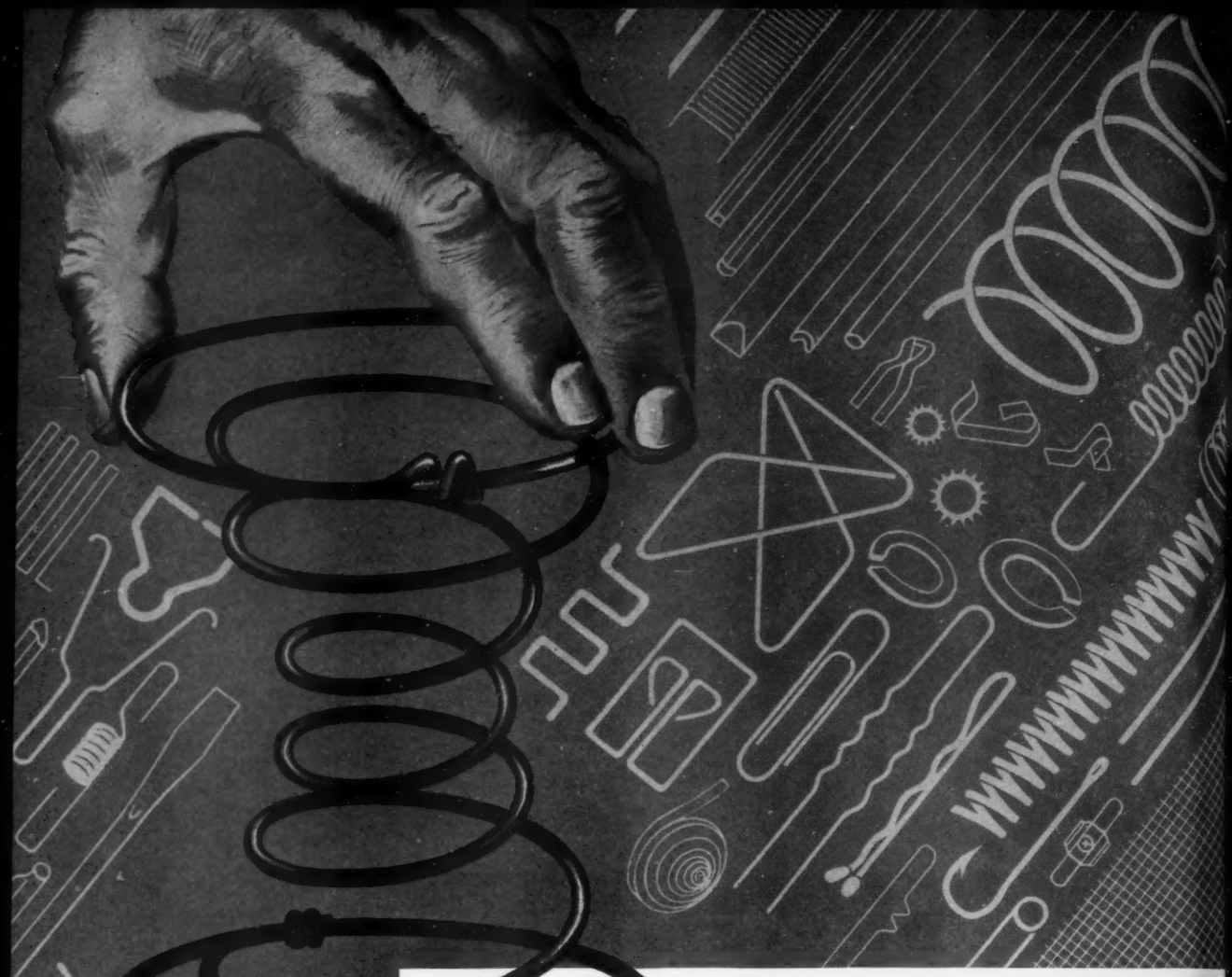
OPALON 1102 Primary insulation for urban distribution wire plus jacketing for rural distribution wire, with outstanding weather resistance, excellent low temperature flexibility.

OPALON 1038 Underground burial cable, with excellent resistance to moisture and long service life.

OPALON 1101 Semi-rigid primary insulation for switchboard wire. High crush resistance, extrusion ease, for critical operation, excellent printability.

OPALON 1006 Primary Insulation for inside distribution cable, with good crush resistance, excellent flexibility.

Special Opalon compounds are available. Monsanto has also developed a complete line of polyethylene compounds for wire and cable insulation.



LET'S TALK WIRE!

This spring is typical of hundreds of types and sizes of springs made from PAGE wire—and springs are just one of the many end products for which PAGE manufacturers wire is a logical choice.

Regardless of your use of wire, you can count on PAGE uniformity. Whether you make hairpins or lock washers, PAGE wire will give you the tensile strength, ductility, finish, tolerance and other properties you require.

PAGE facilities are designed to produce a wide range of high quality manufacturers wire items—including special shapes. Where requirements are exacting, you will find PAGE wire unexcelled.

Since 1902, we have pioneered many "firsts" in the wire industry. The latest of these is corrosion-resistant ACCO Aluminized Wire—commercially pure aluminum bonded to a steel core.

Why not put PAGE experience and knowledge to work for you to improve your product and lower your costs.

Let's get together and talk wire!

ACCO

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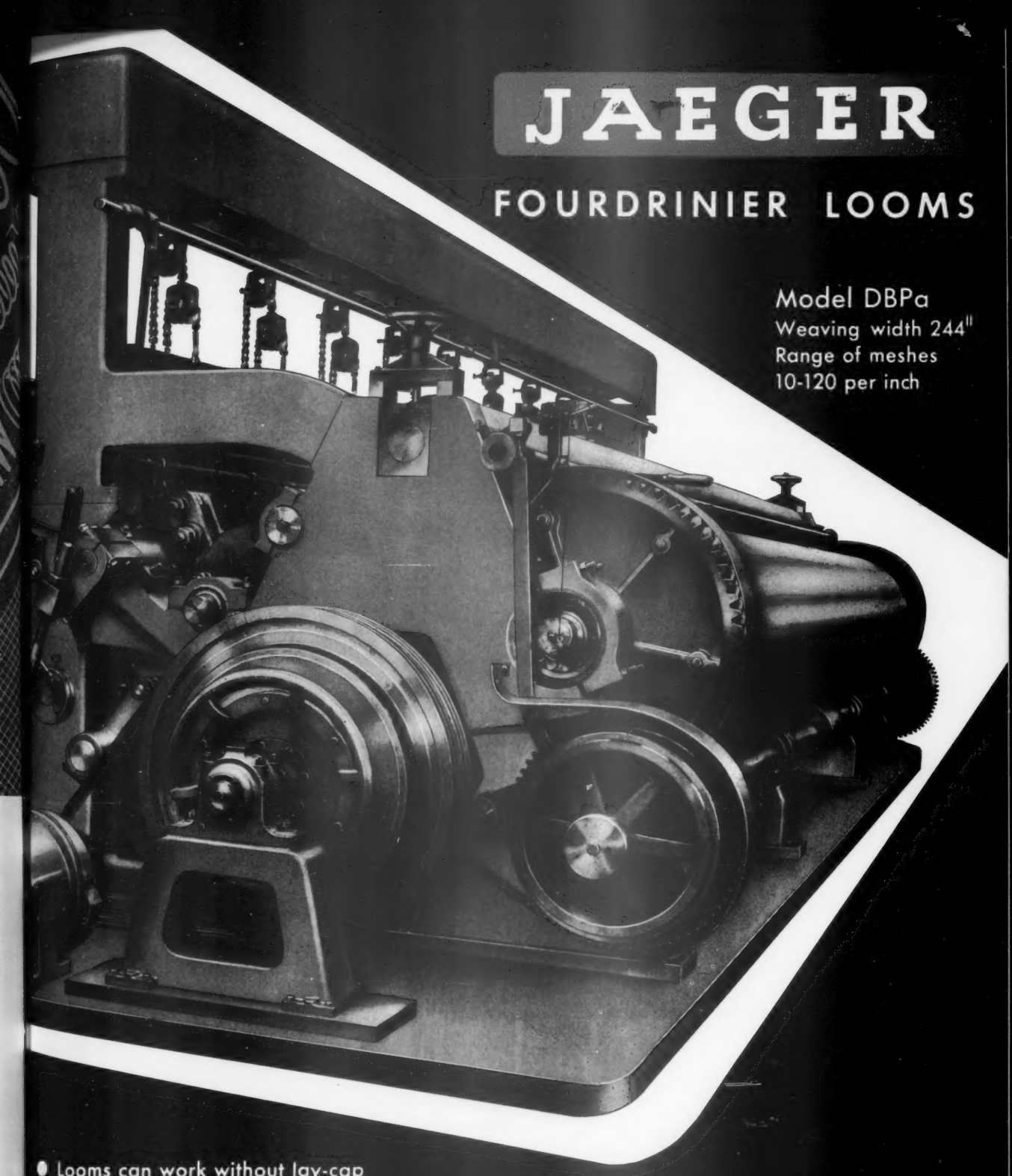
PAGE *-the source for answers to wire problems*



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FOURDRINIER LOOMS

Model DBPa
Weaving width 244"
Range of meshes
10-120 per inch

- Looms can work without lay-cap
- 2-4 driving arms for the lay according to width
- We have a complete line of wire looms and auxiliary machines

Sole Representatives for U.S.A. and Canada

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ANNOUNCING NEW U.S.I. PLANT FOR COMPOUNDING PETROTHENE® RESINS

New Tuscola, Ill., polyethylene compounding unit can process 25 million lbs. per year, guarantees top quality control in resin compounding.

With special process procedures and equipment in its new plant, U.S.I. has achieved a new high in control over compounding factors affecting polyethylene resin performance. This assures manufacturers of maximum weather resistance from PETROTHENE resins for outdoor wire and cable applications.

Carbon black, of course, is added to polyethylene to prevent degradation of the resin on long exposure to sunlight. Without it, polyethylene becomes increasingly brittle at low temperatures and loses its resistance to outdoor weathering.

Factors Affecting Weathering

How well carbon black retards aging, or weathering, depends on three factors: (1) type and particle size of carbon black; (2) percentage of carbon black in the compound; (3) dispersion of carbon black in the polyethylene.

At U.S.I.'s new compounding plant, only "channel black" carbon black of the finest particle size is used in the wire and cable grades of PETROTHENE polyethylene resins. Concentration is set at a point which yields the optimum balance of light screening and other performance properties.

Special processing equipment insures thorough dispersion of the carbon black throughout the polyethylene. This is particularly important, since carbon black gives maximum protection only when it is well dispersed. For example, tests show that a good dispersion will withstand 15 to 20 times as much exposure to sunlight as a poor dispersion.

If you use black electrical grade polyethylene in your products, we'll be glad to send you our new four-page data sheet, "PETROTHENE Resins for the Wire and Cable Industry". Also available is U.S.I.'s comprehensive 100-page "PETROTHENE Polyethylene . . . A Processing Guide". Write us at the address below for your copies.

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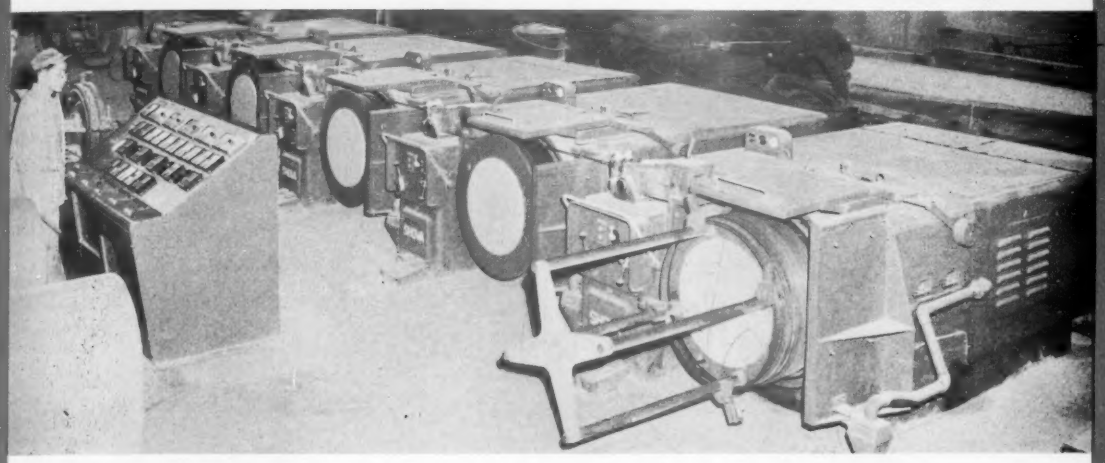
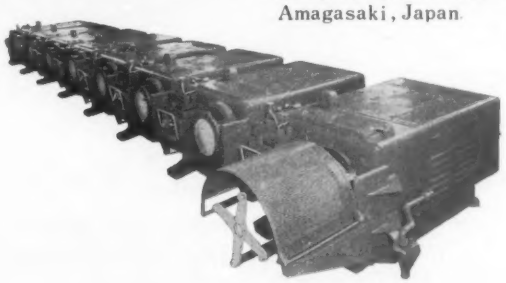


SD-760-5

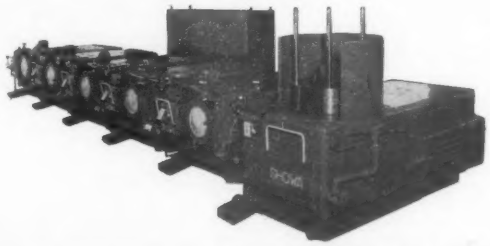
for High Carbon Steel. Maximum 5/8" diameter.
This installation photo shows the view of producing Prestressed Concrete Steel Wire at SHINKO WIRE CO., LTD, Amagasaki, Japan.

(by courtesy of Shinko Wire Co., Ltd.)



SD-500

8 blocks with 20" diameter
for Copper Rod up to 1/2"
Maximum Speed 4000F. P. M.



SD-400

6 blocks with 16" diameter
for Aluminium Wire.
Maximum Speed 2000F. P. M.

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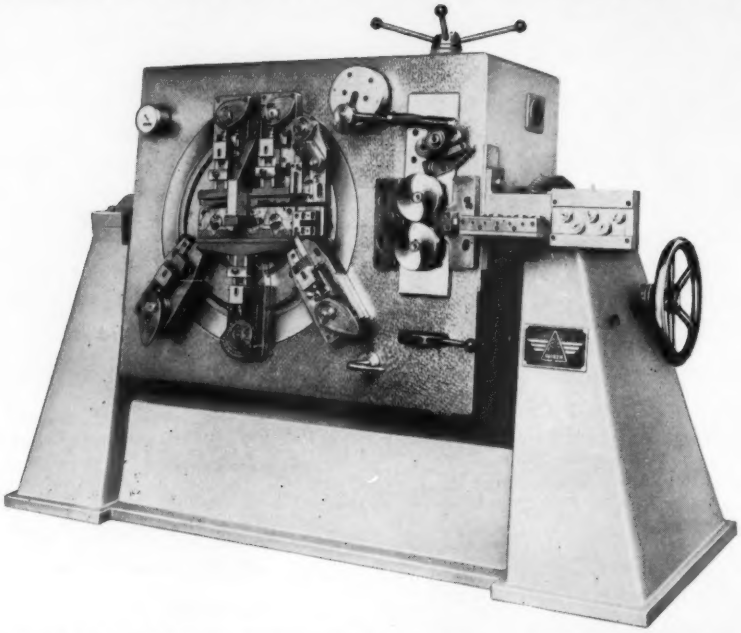
UNIVERSAL MULTI-SLIDE FORMING MACHINES



Model XK 400
for wire up to
¼" diameter.

A complete line of West German-made, Universal Multi-Slide Forming Machines for wire and strip. All models can combine up to 40 operations, with ability to form the most complicated parts, including Pointing, Welding and Forming of Torsion Springs up to 20 coils.

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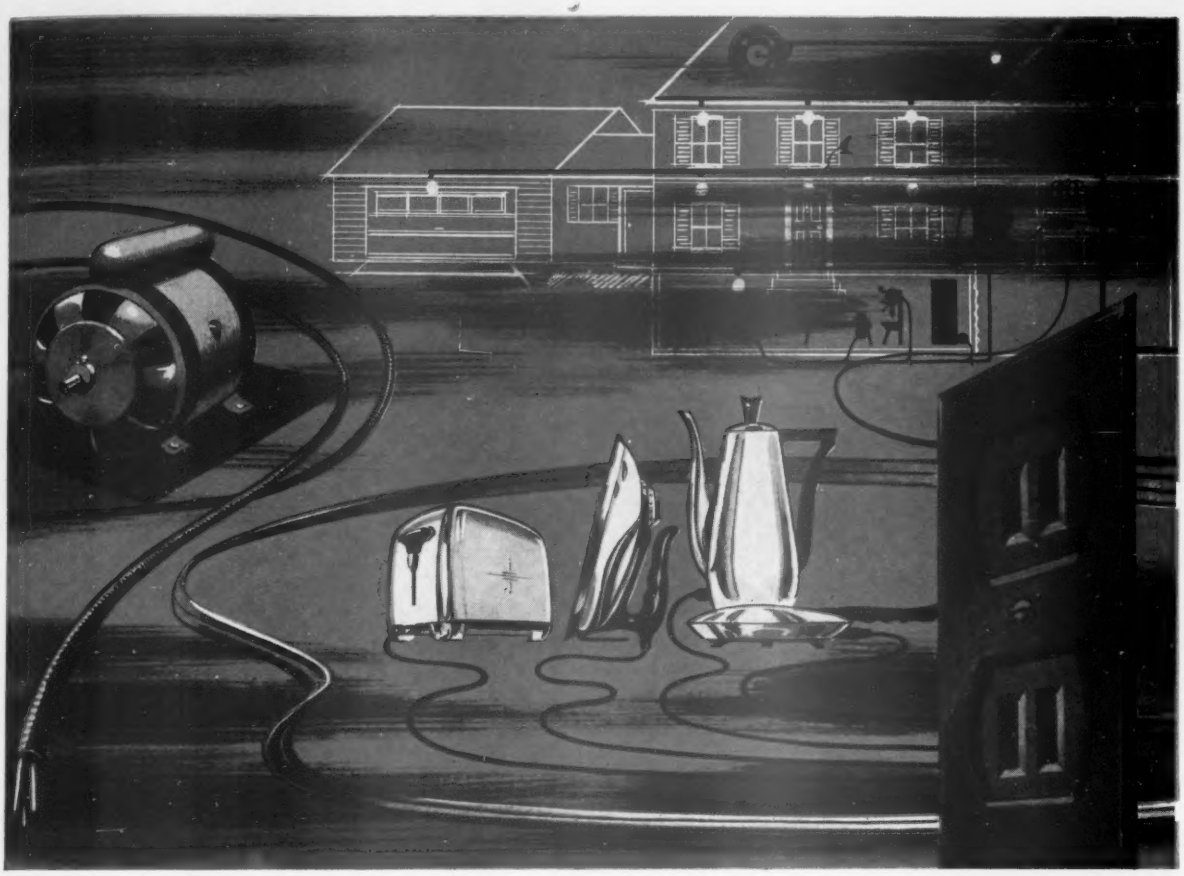
Naugatuck MARVINOL

POLYVINYL CHLORIDE RESINS



four resins for electrical application

NAUGATUCK now offers the Wire and Cable Industry *more* PVC resins for insulation extrusion than does any other resin manufacturer.

Two of these Marvinol® resins, VR-22 and VR-23, have UL approval. These resins are, respectively, of high and intermediate molecular weight. Both have good dry blending properties.

Marvinol VR-24 and Marvinol VR-25 are resins of progressively lower molecular weights. They provide high volume resistivity in semi-rigid compounds with little or no plasticizer. Both deserve your careful evaluation for future electrical products.

Check with your Marvinol technical representative for complete data and evaluation samples, or write us on your firm's letterhead.

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NOW! at low cost twist any number of conductors to make cable up to 1" diameter

only the COOK MULTIPLE INSULATED WIRE TWISTER provides such flexibility

Here's a twister that offers the flexibility required of today's wire mills manufacturing insulated cables. It's truly flexible —you can make any cables required up to 1" diameter.

And, because the COOK MULTIPLE INSULATED WIRE TWISTER is so low cost, it is the practical addition to your plant. Compare it with any other machine on the market doing this work . . . compare its performance . . . compare its cost . . . compare its construction. Why not see for yourself . . . write for complete specifications and prices today.

SPECIFICATIONS

Production	9,000 ft/hr at 7½" lay
Reel Size	30" std. also from 16-36" dia.
Floor Space	6 ft. x 8 ft. max.
Lay Range	¾" to 7½"
Twist	Right or left hand
Finished Wire Size	Up to 1" dia.
Wrapping Head	Optional
Neutralizer	Optional

COOK

MANUFACTURING CO.

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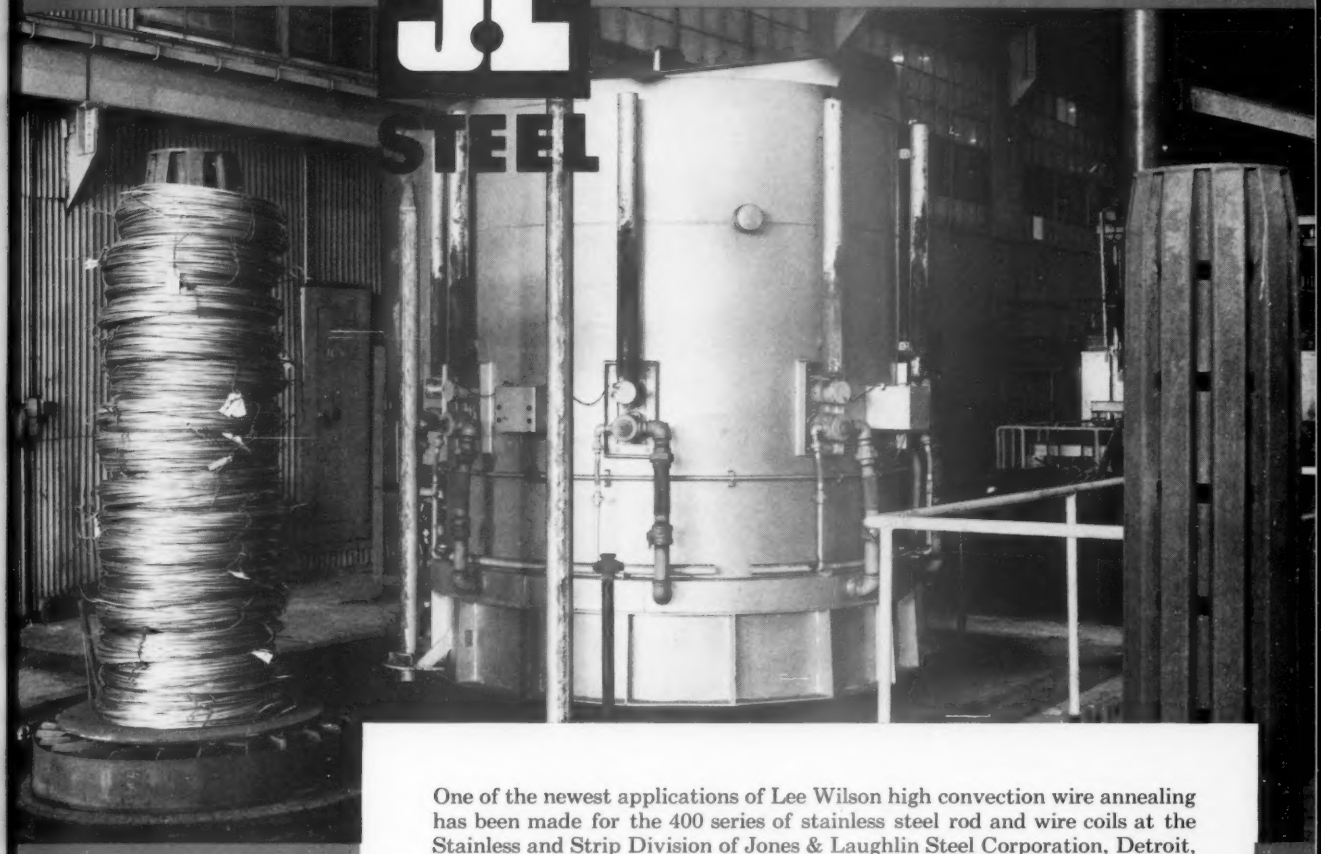
STAINLESS ROD and WIRE ANNEALING AT J&L STEEL DETROIT



One of the newest applications of Lee Wilson high convection wire annealing has been made for the 400 series of stainless steel rod and wire coils at the Stainless and Strip Division of Jones & Laughlin Steel Corporation, Detroit, Michigan.

The background for this application is the many splendid installations for the same material in strip form so the design details, especially the application of gas circulation to temperature from 1550 to 1600°F., was already well developed.

This particular installation consists of a furnace and two bases with a charge diameter of 48" and a piling height of 90" for annealing either rod or wire coils of the 400 series, with charge weights of approximately 3600 lbs.

For types 410 and 430 cold heading material, the Rockwell B readings after annealing range from 77 to 80. With the high gas volume of circulation, these readings are the maximum spread in the charge. Since no atmosphere is used in this type of work, all materials within the furnace are made of alloy. The scale produced on the wire is very easily removed for further processing.

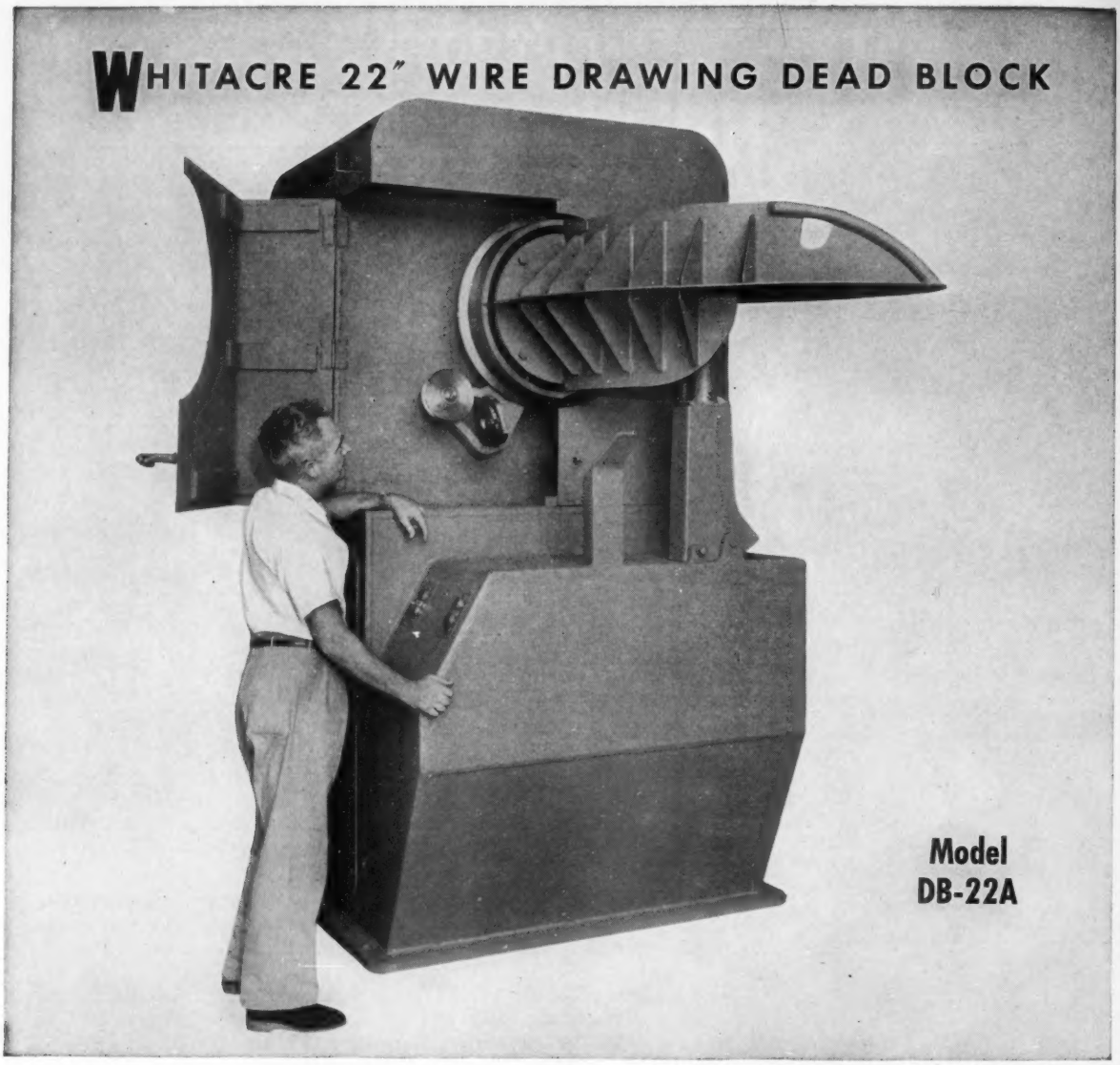
This application should prove of wide interest to the many plants now engaged in the expanding production of stainless materials of the 400 series.

Lee Wilson* ENGINEERING COMPANY, INC.
20005 LAKE ROAD • CLEVELAND 16, OHIO

HIGH CONVECTION ANNEALING FURNACES
MAKE THE BEST METALS BETTER

*ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNACES

WHITACRE 22″ WIRE DRAWING DEAD BLOCK



Model
DB-22A

Continuous Production—Efficiency Approaching 100%

Gives you these advantages

Continuous increased production achieved by: • No down time for stripping • Permits packaging into stationary container or uninterrupted palletizing on stems • No tangling nor snarling from handling • Design simplicity. No back-gearing nor similar mechanisms • Greatly reduced floor space requirements • Dies in supplying drawing machine can be changed without stopping dead block • Accumulation type machines can be "run down" without stopping dead block • Continuous inspection and sampling • Breaks welded in production — low scrap loss • Increased production with lessened operator fatigue • Maintenance eliminated except for occasional lubrication of four main bearings and two motor bearings • Dead block can be located anywhere with wire literally piped from wire drawing machine • Extra large packages for in-process wire • Greatly reduced handling and in-plant transportation costs • Low capital investment.

OTHER MODELS AVAILABLE

16″ Wire Drawing Dead Block, Model DB-16A • 26″ Wire Drawing Dead Block, Model DB-26A • Combination 16″ and 22″ Galvanizing or Tinning Dead Block Take-ups, Model GB-2216A • 26″ Heavy Wire Galvanizing or Tinning Dead Block Take-up, Model GB-26B.

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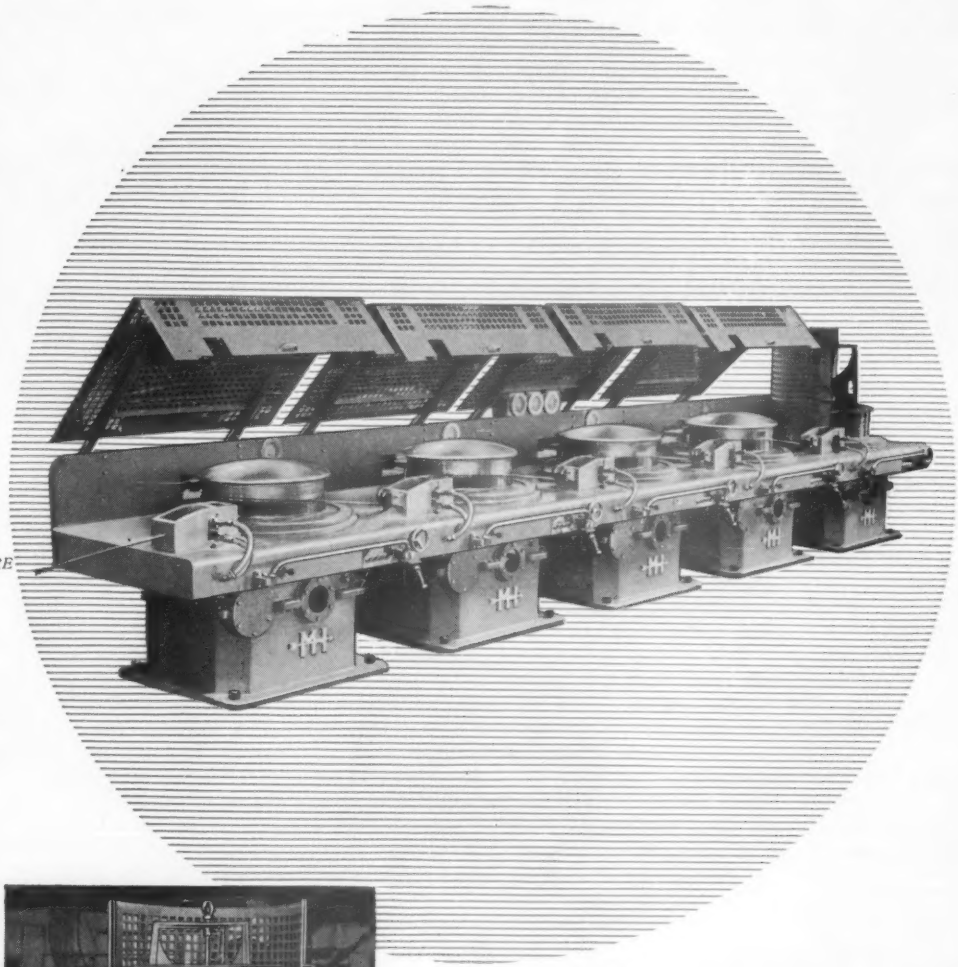
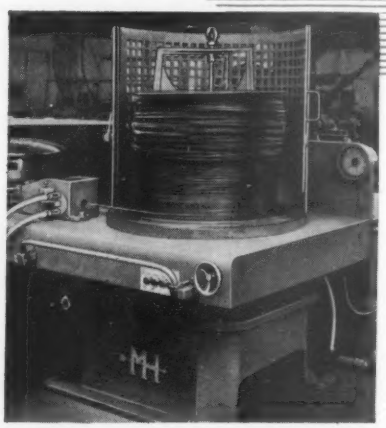
WORLD WIDE
PRECISION WITH RUGGEDNESS



The heavy size: BEELINE DG-5 with five 28" blocks for PRESTRESSED CONCRETE WIRE max. about .55" rod.



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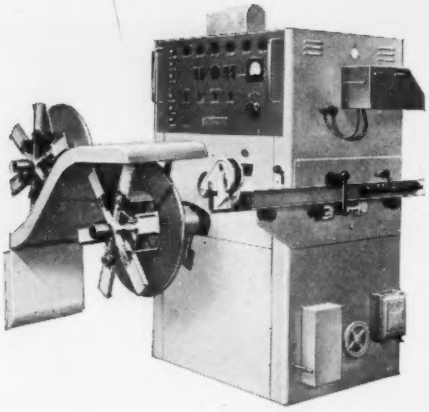


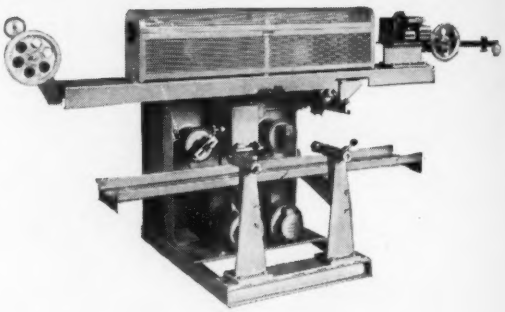
A NEW MODEL BV MACHINE for General Applications

Available with driven pay-off, constant wire speed and automatic reverse. For despatch coiling, non-returnable reels and shop reels up to 36" dia. Head speed 600 r.p.m., line speed 3,000 ft. per min.

A NEW MODEL LD MACHINE for Telephone Cable and Switchboard Wire

Including both reels driven with low speed reverse, controlled acceleration and braking, and constant wire speed.

Shaftless centres and a new reel handling system to reduce down time. For tensions down to 1¼ lbs. reels from 10 in. to 18 in. diameter. Adaptors for large in-feed and non-returnable take-up reels available. Head speed 2,500 r.p.m., line speed 2,000 ft. per min.



A NEW MODEL MD MACHINE for Coil Re-winding

Available with driven pay-off, constant wire speed and automatic reverse.

Shaftless centres.

For reel to reel re-winding where coil length or fault level preclude semi-automatics, e.g. on longitudinal insulated wires.

Head speed 400 r.p.m., line speed 3,000 ft. per minute.

A NEW MODEL OA MACHINE for Armouring Wires

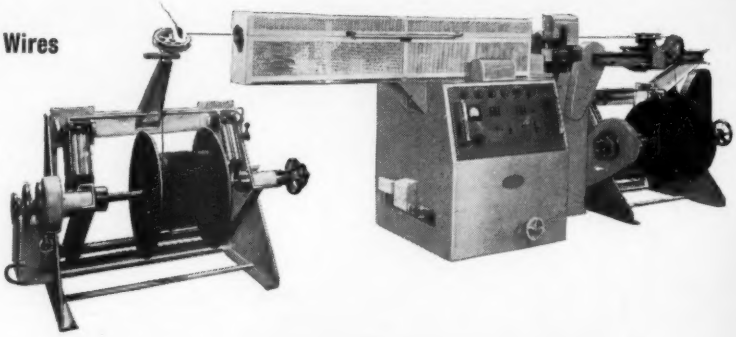
Including low torque start.

Accurate measuring and pre-form rollers.

Shaftless centres and a new reel handling system.

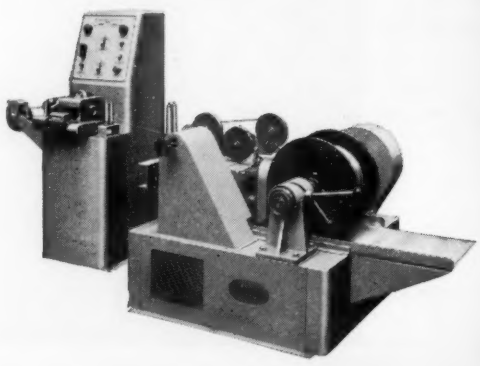
For high tensile wires up to 0.1 inch diameter, mild steel wires up to 1.25 in. diameter and reels up to 30 in. diameter.

Head speed 600 r.p.m., line speed 1,000 ft./min.



SPARK TEST, MEASURING, SURFACE FAULT DETECTOR AND PATCHING EQUIPMENT AVAILABLE.

General Engineering Co (Radcliffe) Limited



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Good news in Anti-friction action...

SWIFT now offers a FAMILY OF FIVE...

Swift's new line of high heat resistant, long mileage lubricants are now available to serve a variety of drawing and metal processing jobs.

Flexals are extremely versatile. A wide range of chemical and physical properties makes them particularly adaptable for difficult or highly specialized jobs. For example: Flexals can be furnished for cold heading, hot dip coating and dry drawing of high or low carbon wire. They can be soluble in water . . . or *insoluble* in both water and solvents. Melting points range to 800° F. They are offered in controlled grinds down to micron particle size.

Look over Swift's new *Family of Five* FLEXALS . . . with *your* process in mind. Then, write for details on a trial order of these versatile new ANTI-FRICTION lubricants.

FREDDIE FLEXAL invites your further inquiry.

FLEXAL S	Hot dip, dry film lubricant and rich, dry drawing compound.
FLEXAL CS	Fine calcium stearate; 58°-60° C. titer, 325 mesh.
FLEXAL MCA	Metallic stearate base. Medium vari-grind compound.
FLEXAL MCF	Metallic stearate base. Rich, fine mesh drawing compound.
FLEXAL MCL	Lean, fine, dry lubricant for low carbon bright and cold heading wires.

To Serve Your Industry Better

Swift
104TH YEAR

S-53

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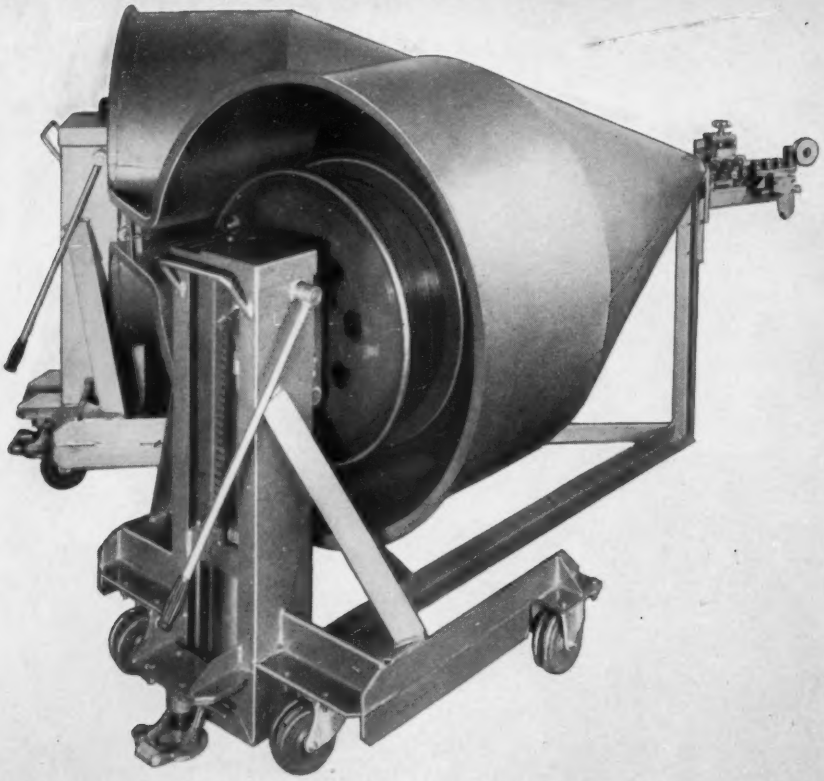
STEP UP YOUR EXTRUDER LINE CAPACITY



SIMPLIFY REEL HANDLING PROBLEMS WITH THIS ENTWISTLE HIGH SPEED UNIT.

Your extruder line operation will reach a new high in speed and efficiency with the Entwistle Dual Flyer Pay-Off. This unit enables continuous pay-off of wire at speeds in excess of 3500 FPM, reel weights up to 1500 lbs., and wire sizes down to No. 26 A.W.G.

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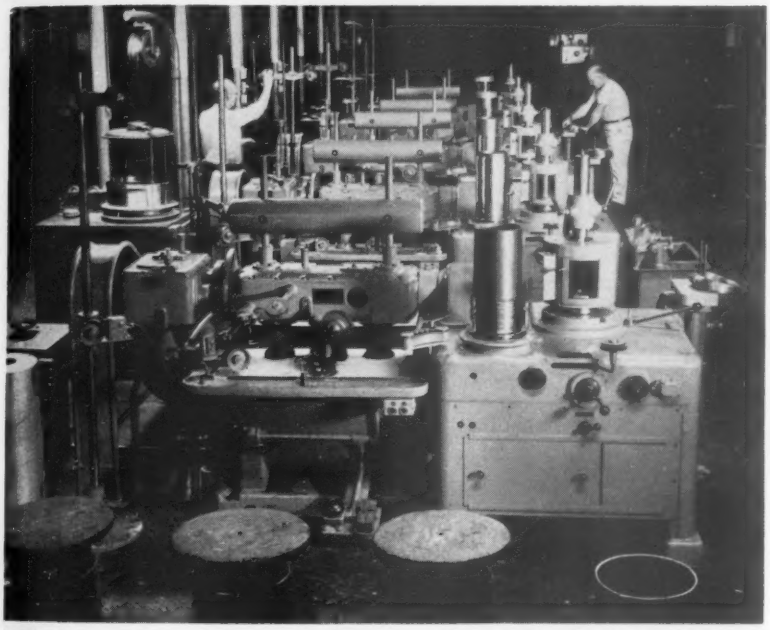
BEFORE: Here, wire is being drawn "the old fashioned way."



AFTER: Shiny and new, with the look of tomorrow, the new wire drawing equipment at Prentiss produces wire better and faster.

NEW WIRE MACHINES UP PRENTISS OUTPUT

Five new wire drawing machines have been installed at Prentiss Wire Mills, Riverside-Alloy Metal Division, according to J. R. Fuller, manager of Prentiss. The new high-speed equipment has replaced ten rows of antiquated single hole tub drawing benches.

The new wire drawing machines are now in production and have drawn wire down to .008 inches diameter, only slightly thicker than a human hair, maintaining extremely close tolerances. They will be used to draw all types of wire including non-ferrous alloys and high and low carbon steels.

After drawing, the machines automatically wind finished wire on spools or cores with capacities from 10 to 60 pounds, or in coils. Increased spool capacity pays off for customers by permitting longer uninterrupted production runs.

A number of new specialty wire products are now practical with the precision, high-speed equipment which constitutes the latest step in the continuous modernization of Prentiss Wire Mills.

"PRENTISS" adds "HERBORN" Wire Drawing Machines To Their Line

"HERBORN" TF IIIc Wire Drawing Machines photographed at the plant of Prentiss Wire Mills, Riverside Metal Alloy Division, H. K. Porter Company, Inc., at Holyoke, Massachusetts.
*** Photos and text courtesy "Re:Porter," published monthly by H. K. Porter Company, Inc.**

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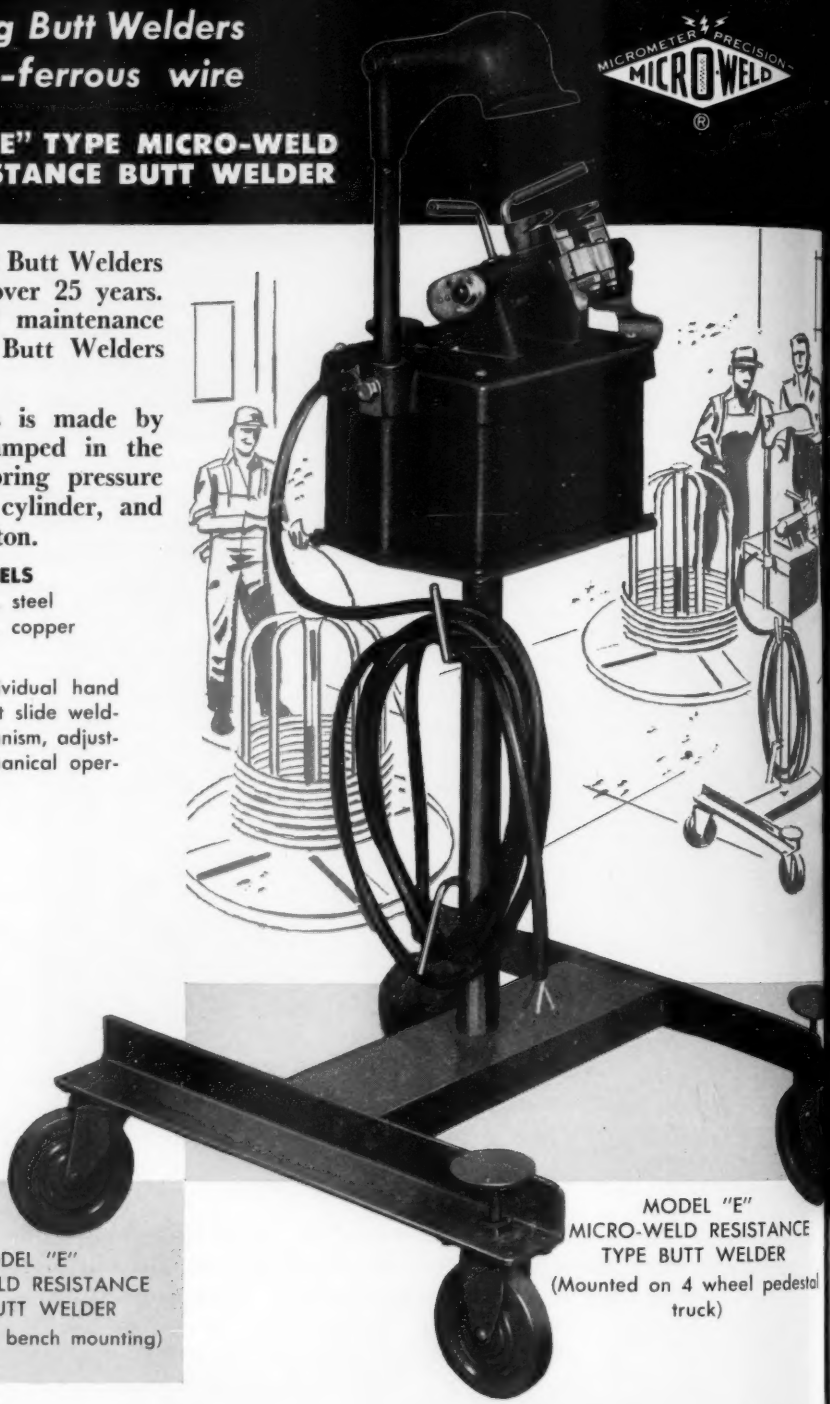

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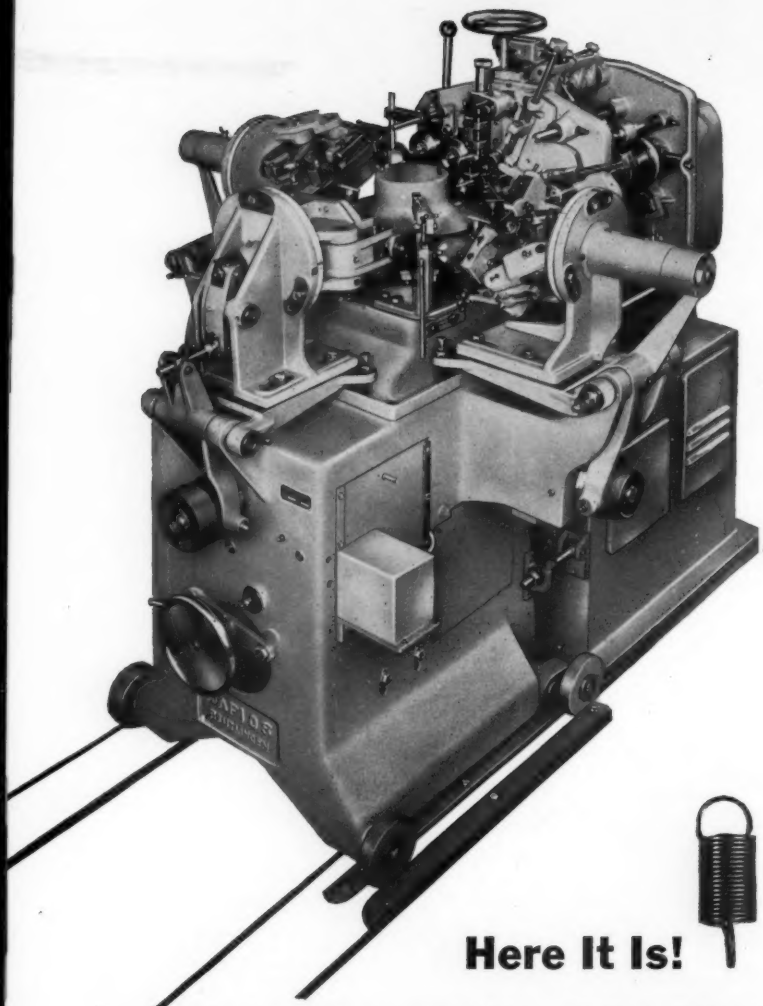

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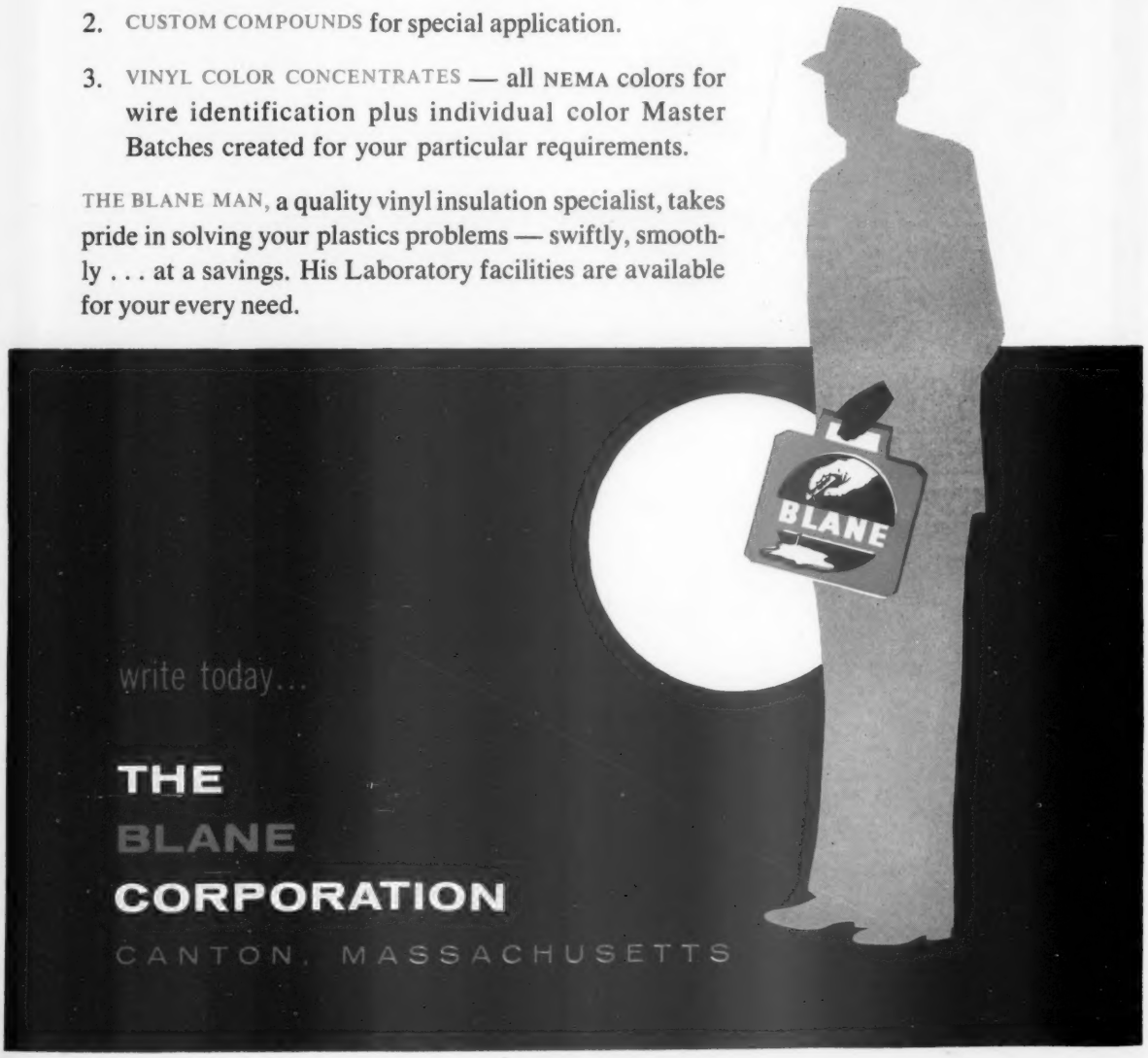

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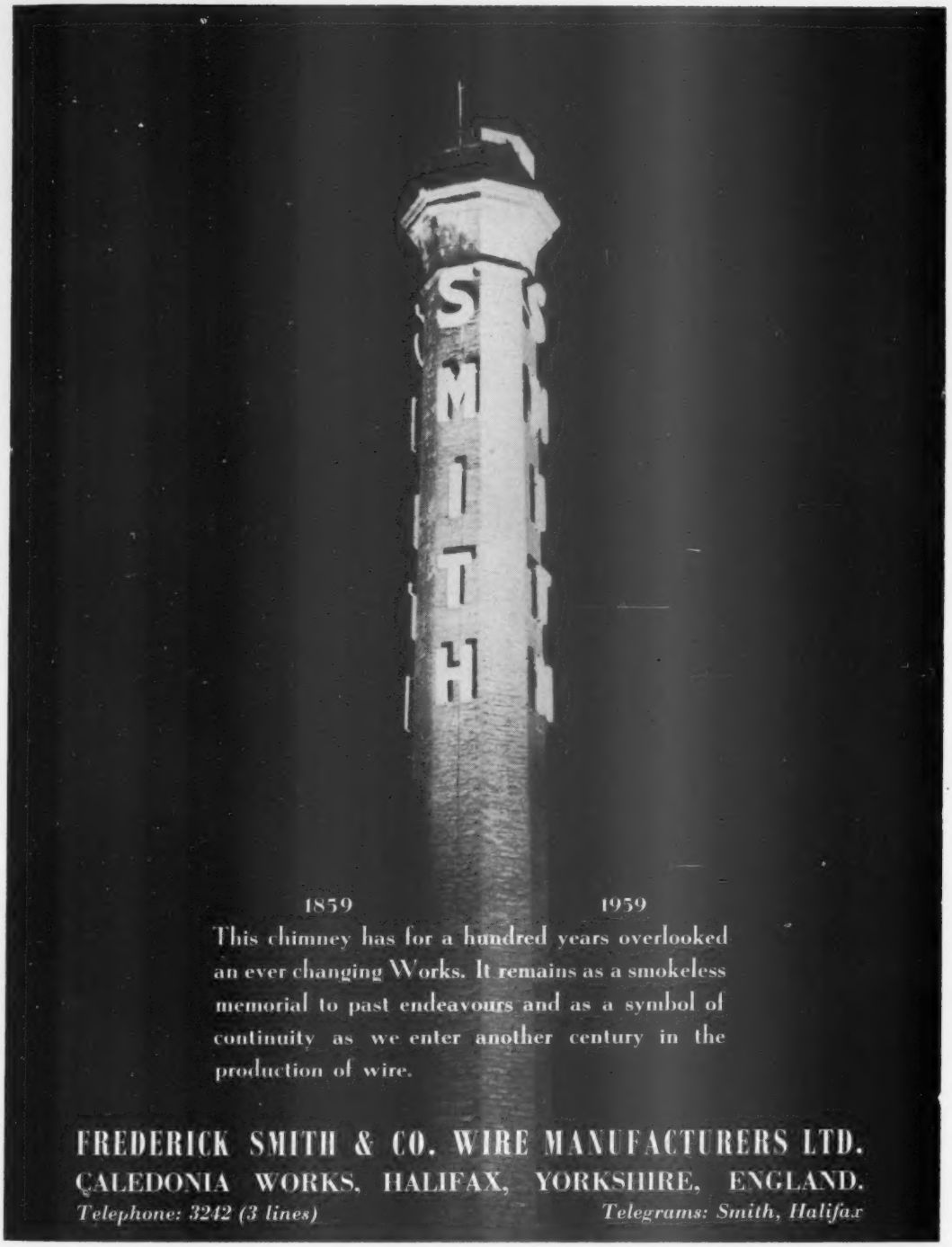

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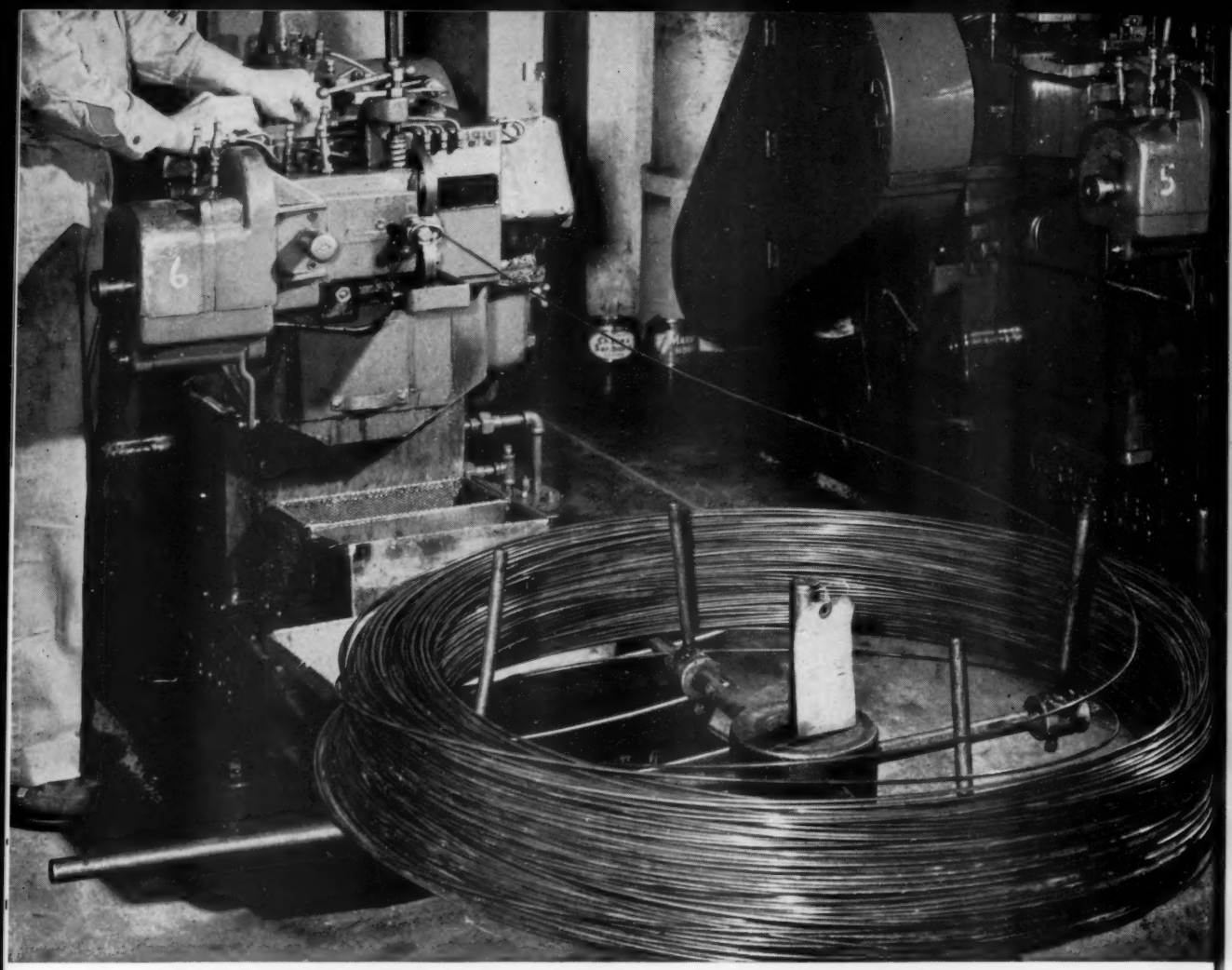


The high degree of plasticity of J&L special heading screw wire and its freedom from surface defects have virtually eliminated splitting problems for Midland Screw Corp.

At Midland Screw Corporation

J&L special heading screw wire solves tough recessed-head screw production problem

Midland Screw Corp. of Chicago, at its Millersport, Ohio, plant has found J&L special heading screw wire "... a consistently high quality product that we can depend upon."

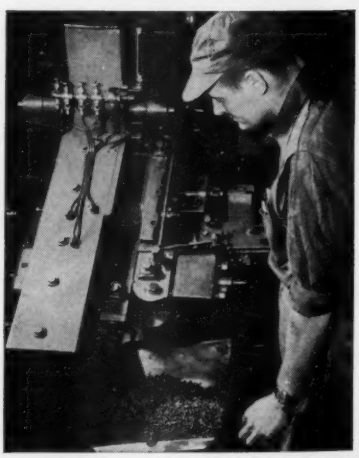
Midland makes 4,500 kinds of screws, all to very close tolerances. The recessed-head types include round heads, oval heads, pan, flat heads, truss heads and others.

Recessed-head screws are tough to make because of the extraordinary demands on the steel wire during multiple heading operations. The wire must have a high degree of hardness. And, *after* it has become even harder from the initial cold heading blows, it must have enough plasticity to take the final indent.

The wire must be free from harmful surface defects. Since the pressures involved alone are sufficient to cause serious splitting with ordinary heading wire, any seaminess can accentuate this problem.

Midland also uses J&L special heading screw wire for other screws with heads that are difficult to form. One of these, made from .133-inch wire, is an indented hexagonal washer head. The washer on the finished screw is .370 inch—or almost three times the diameter of the wire.

For more information on J&L special heading screw wire, call your J&L representative. Or write to Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.



Midland makes recessed-head screws at rates up to 13,800 per hour on each machine by using J&L special heading screw wire.

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B. J.—
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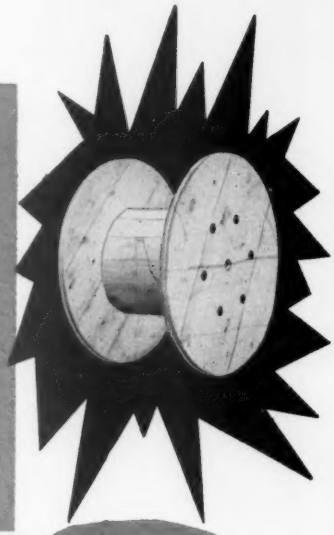

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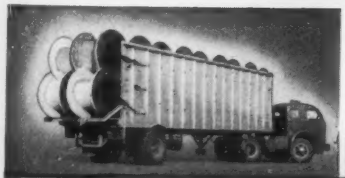
NON-RETURNABLE REELS GIVE YOU A DEFINITE PACKAGING COST



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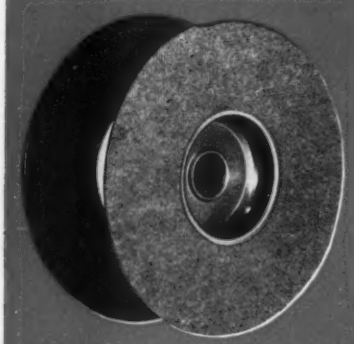
HUBBARD is headquarters for any reel or spool requirement.



Reel with a masonite flange and cardboard hub assembled with steel end washers for domestic and export shipment of wire, tape, braid or other materials.

Heavy Duty Precision Brazed Steel Spool for drawing and processing of wire. Strongly and accurately made for long service.

Non-Returnable Magnet Wire Shipping Reels designed for high-speed wire take-off. Light in weight, low in cost, high in impact and tensile strength. Ideal for palletized shipments.

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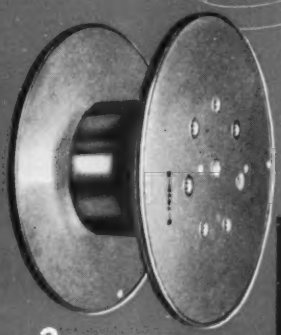

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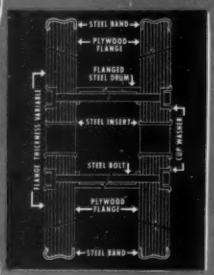

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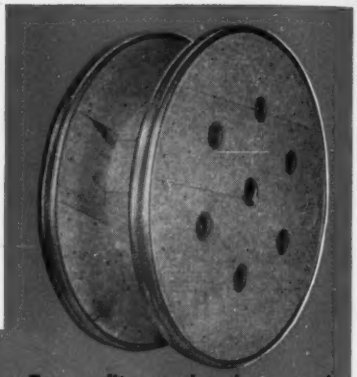
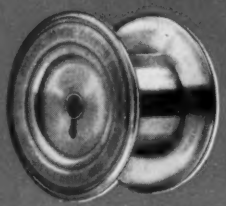


Top quality wood reels armored with cadmium steel for maximum strength and long service.



Aluminum Reels designed for customers' appeal. Heads are strong. All welded construction. Smooth surfaces. Tare weight uniform. Ideal for bulk shipping.

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The Wire Outlook

If anyone has had doubts about how this year will go, they should be dispelled by now. On almost all fronts business is moving ahead even faster than expected. A well-known observer looks for a slight set-back in the third quarter—then an entry upon what he terms "the golden sixties."

The steel industry will be affected if the threatened strike materializes—as it seems now quite likely—but manufacturing in general should carry on at an unabated rate.

Automobile sales are exceeding previous estimates, construction activity in residential and commercial buildings is strong, public works projects are being accelerated, and the industrial contract trend is upwards.

Personal incomes are reported to be up $3 billion and are higher than a year ago by $23 billion. The current figure is at an annual rate of $372.5 billion. Wage and salary increases account for most of the recent gains.

May employment figures are markedly better. Fourteen major industrial areas have been removed from the list of those parts of the country having a substantial surplus of labor and in 149 of the areas surveyed, 90 percent show reductions in unemployment.

As an offset to the "boom" trend, rising interest rates are likely to have a restraining effect. The loss of gold by the country is another curbing factor. Gold has been flowing out very largely due to the changing international balance of trade picture. Whereas we were once exporting more than we imported, the reverse is true today, with all due respect to the claims of labor's leaders, who hold that wage increases are not inflationary.

In this last connection, the use of the new St. Lawrence Seaway has opened the central states to an influx of rods, wire and wire goods. These also come into several points along the Eastern seaboard, into the Gulf ports, and to cities located on the West Coast.

While our wire mills are doing better, they are far from doing as well as they could or should. No part of the country is now isolated by higher rates from import competition.

Manufacturers' wire continues in good demand and, while merchant wire product sales have been seasonally active, goods arriving from abroad have cut seriously into the market. So much so that one major producer has announced the abandonment of this class of product—that is, farm fencing, barbed wire, etc.

Sales of wire mesh for road building has failed to attain expected proportions largely because of depleted state funds for roads.

The market for bars has been moving up, the wire rope business has improved, and most types of wire are selling well. There may be a slackening in demand for automotive wire in the summer, which usually occurs when the plants begin to tool up for new models. Wire sales are better because of the excellent demand for rods, wire, and products made of wire in every quarter. Deliveries have become somewhat extended due to the hedging against the possibility of a strike.

The wire business on the West Coast is active in spite of the fact that 51% of the nails sold are reported to be coming in from foreign sources, and that 57% of the barbed wire market is being similarly supplied.

On the retail front, it is interesting to observe that stores are enjoying an upsurge in consumer buying. "Hard" goods retail outlets have rung up a record dollar value and "soft" goods stores are running over 4 percent higher than last year. The National Retail Merchants Association estimates that sales this year will be about 5 percent higher than in 1958, totalling 210 billion dollars.

Prosperity is good for everyone, but in the eager-beaver desire of labor to get more money, let us not price ourselves entirely out of the markets of the world.

Edmund Duval Sickels
EDITOR

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A monthly publication devoted to the production of Wire, Rod and Strip.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 34 JULY, 1959 No. 7

Common Extrusion Problems and Their Solution

by John L. Young
Technical Service Representative
Vinyl Resins and Compounds
Plastics Division
Monsanto Chemical Company
Springfield, Massachusetts

This paper was presented at the Regional Meeting of the Electric Wire and Cable Section of The Wire Association at Boston, Mass., on April 29, 1959.

During the past several years a number of articles on thermoplastics have been written detailing theoretical explanations of the flow and shearing action within the barrel and head of the extruder. This work has contributed to many of the outstanding advances in new machine design and development of high speed extrusion techniques. These theories serve as useful guides for understanding many of the every day problems which occur in wire and cable extrusion. In light of this background, this discussion will present some techniques for eliminating such problems encountered on production extruders of conventional design, in good mechanical condition and run by competent operators familiar with plastic extrusion.

★ ★ ★

Although the general subject of this article is common extrusion problems and their solution, its scope, more specifically, is extrusion problems occurring with polyvinyl chloride compounds and dry blends (i.e., powder mixed materials). The almost limitless number of possible combinations of plasticizers, fillers and other additives and the chemical nature of PVC resin itself, which is susceptible to thermal degradation at elevated temperatures, offer a varied and interesting area for study. Many of the problems experienced with vinyl extrusions are also applicable to other thermoplastics.

★ ★ ★

Normally, any and all of the defects covered in this article occur in both dry blend and compound extrusion. In general, the extrusion of dry blend in properly designed equipment will be as easy for the experienced operator as extrusion of granulated compound. Proper design of the extruder is particularly important in dry blend extrusion for the machine is not only melting and forming the vinyl—it is also mixing, fluxing, and shearing the material—work normally accomplished on compounded stock by a banbury mixer, sets of mill rolls, or other intensive compounding equipment. Where circumstances make it necessary to run dry blend on short barrelled machines, suitable for compound but inadequate for dry blend extrusion, defects due to insufficient mixing and fluxing become problems.

★ ★ ★

In general, the major extrusion problem areas fall into four categories:

1. **Rate problems such as low output rates, or variable rates causing fluctuation in the O.D.**
2. **Surface appearance defects which include pimples, dimples, grainy surface, lumpy surface, die lines, grooves, and other defects related to die design.**
3. **Porosity—voids or holes within the wall of the primary insulation or cable jacket. These voids can be caused by occluded air, moisture, or degradation.**
4. **Failure of constructions to meet specification tests such as insulation resistance, dielectric strength, aging, minimum tensile requirements, heat shock, heat resistance, soldering and cold bend tests, etc., can be directly related to deficiencies in extrusion equipment and techniques.**

★ ★ ★

Remedial action for these problems ranges from minor changes in operating conditions or materials handling methods to basic redesign of equipment. In order to keep machines in operation and production on schedule, it is often necessary to make adjustments in operation to overcome a problem with a given construction. These adjustments

may only be temporary expedients to correct deficiencies in operational or maintenance techniques, and perhaps even basic equipment design such as:

1. Screw design
2. Die and approach design
3. Conductor handling and take-up equipment

★ ★ ★

The advances of recent years made in extrusion theory have contributed substantially to improvements in equipment design concepts. It is also found that adjustments normally made by an experienced operator to improve the operating conditions of his machine, although developed over the years through trial and error, fit well with theory. In addition, a knowledge of viscosity, flow, and pressure requirements is a useful guide in determining when and how much to adjust temperatures, guider spacing, and screen pack. A tabulation of the most commonly encountered extrusion problems, basic causes, and the recommended corrective actions determined with these factors in mind is presented in this article (see chart on succeeding pages).

★ ★ ★

To determine the proper corrective action from the chart, it is necessary to ascertain carefully the basic cause of the defect. Porosity in an extruded section, for example, can be caused by moisture (see Figure 1, specimens C and D), entrapped air (see Figure 2), or degradation (see Figure 3, specimen B). Action taken to remove porosity presumed to be due to occluded air can actually make the defect worse if the porosity has been caused by degradation and would have only an indirect effect if the porosity were due to moisture in the feed stock. Poor surface appearance can be caused by fisheyes (Figure 1, specimen A); uneven stock viscosity (Figure 1, specimen B), which may or may not occur along with fisheyes; porosity due to moisture; degradation (Figure 3, specimen A); or a pitted or rusty die (Figure 4). Each of these basic problems requires a specific remedy, and before the surface defect can be cleared up, the basic problem must first be established.

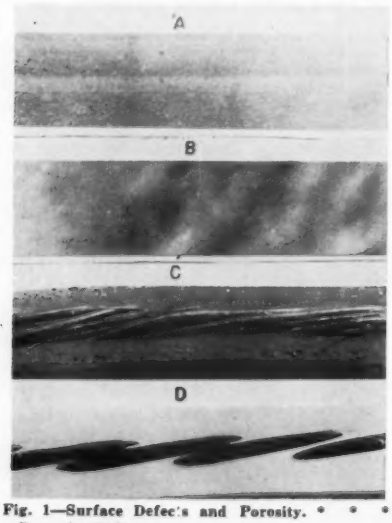

Fig. 1—Surface Defects and Porosity. * * *
Spec. A—Fisheyes.
Spec. B—Bumpy surface due to uneven viscosity.
Spec. C | Porosity due to moisture.
Spec. D |

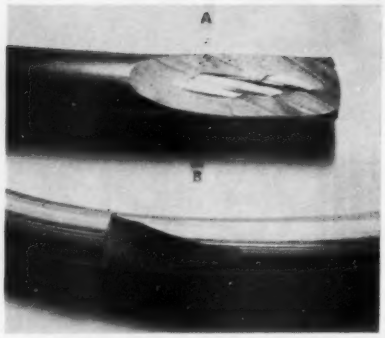

Fig. 2—Porosity Caused by Occluded Air. * *
Spec. A—Heavy section at high take-off rate.
Spec. B—Same section at 30% lower rate.

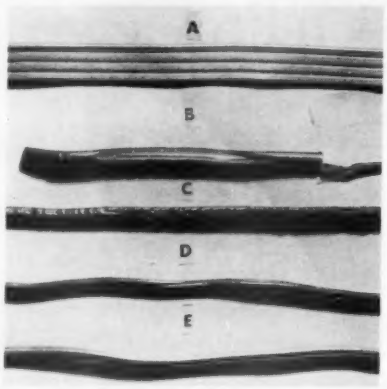

Fig. 3—Problems from Degradation. * * *
Spec. A—Bumpy surface.
Spec. B—Porosity.
Spec. C—Pitted surface.
Spec. D | Grooves in surface.
Spec. E |

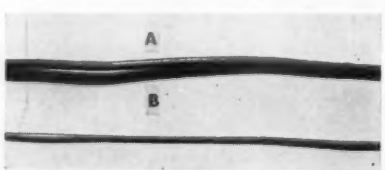

Fig. 4—Condition of Die Important. * * *
Spec. A—Wire extruded with pitted, rusty die.
Spec. B—Wire extruded, same machine, with clean, highly polished die.

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Knowledge of the equipment and how an adjustment affects its operation is also necessary in determining what must be done to correct a given defect. For example, increased screw cooling water to cool the forward end of a screw increases the viscosity of the plastic next to the screw surface. This decreases the effective flight depth of the screw in the melt section of the extruder which tends to increase the amount of work done on the material. However, cooling the forward end of a comparatively deep flighted screw may cool the material before it is completely melted and retard the stock from reaching melt temperature. In this case, screw cooling may shorten the melt zone, lower stock temperature, and actually decrease the amount of work done on the stock.

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Adjustment of barrel heats to regulate the amount of heat conducted into the material in the barrel should be made to complement adjustments in screw cooling water. Depending on the particular extruder design, certain heat zones will have more effect at controlling temperatures. In some extruders, and particularly at very high extrusion speeds, the stock temperatures are largely determined by the heat generated in the working action of the screw on the stock. In these cases adjustment of barrel heats has little effect on stock temperature, and, in fact, barrel cooling may be required.

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For many extruders the rear zone largely determines the final temperature as the stock leaves the barrel. With other specific screw designs the middle or front section may have even greater effect on the stock temperature. Only a person who thoroughly understands the operation of a given extruder can say which zone to adjust to obtain the desired increase or decrease in stock temperature. Table I illustrates the necessity of proper stock temperature for development of maximum properties of a given material.

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CHART OF COMMON PROBLEMS ENCOUNTERED IN THE EXTRUSION OF PVC AND THEIR SOLUTION

CHART OF COMMON PROBLEMS ENCOUNTERED IN THE EXTRUSION OF PVC AND THEIR SOLUTION

Symptom	Basic Defect	Constructions Normally Exhibiting Defect	Cause of Problem	Immediate Corrective Action: Preferred	Immediate Corrective Action: Alternative	Major Improvements Needed
I FAILURE OF CONSTRUCTION TO MEET PROPERTY TESTS						
A. Low, variable insulation resistance	Strains and microscopic cracks due to strains on the inner and outer surfaces	Thin wall primary insulation on small gauge wire and thin wall jackets	Cold conductor or core	Preheat conductor to 280-300°F with flame or electric preheater	Drastically decrease take-off speed	Installation of controllable wire preheater
Low retention of elongation after aging and low initial tensile properties			Cold water bath close to die	Increase temperature of initial portion of water bath to 180-200°F by: 1) adding hot water to bath 2) bubble steam thru bath 3) shut off cold water and allow bath to warm up from insulation heat	Run at high stock temperature Increase length of air gap between die and water trough	Increase length of water trough
	Overheated material		Foreign contamination and degradation	See IIC and IIIF Lower stock temperature*	See IIC and IIIF	See IIC and IIIF
B. Low initial tensile properties	Improperly fused stock	Heavy wall jackets	Improper stock temperature and inadequate working	Increase stock temperature and working**		Appropriate redesign of screw
C. Test failures in:	Strains due to poor flow in approach to die which cannot relax during cooling of insulation or jacket and/or excessive drawdown	Thin wall primary insulation	Cold conductor	See IA	See IA	See IA
heat shock			Cold water bath close to die			
heat resistance soldering			Non-streamline die approach	Polish and clean surfaces of die and approach		Replace die and guider with well streamlined, highly polished die and guider
cold bend			Obstructions in path of flow causing non-streamline flow	Remove thermocouples or other obstructions from flow path		Install thermocouples or other instruments which protrude into path of flow well back in crosshead
			Oversize die opening requiring high drawdown ratio to maintain size	Switch to die with opening approximately same size as construction or no more than 5-8% greater on an area basis		
II POROSITY						
A. Voids occurring generally throughout the entire wall of jacket or insulation	Entrapped air in extruded section	Heavy wall jackets and primary insulations	Melt zone too far forward in barrel to force entrapped air back through hopper	Increase screen pack—more or finer screens	Decrease take-off speed and extruder RPM	Extend barrel length to at least 20/1 L/D
			Inadequate screw design for low back pressure extrusions	Decrease space between wire guider and die		Replace screw with shallower flight depth metering section screw
			Too large construction for extruder capacity	Use long land dies	Switch heavy wall constructions to larger machines	
				Adjust screw cooling water		
				Raise temperature of controlling barrel heat zones		
				Preheat feed stock to a constant temperature prior to extrusion		

Chart of Common Problems Encountered In The Extrusion of PVC And Their Solution—Continued

Symptom	Basic Defect	Constructions Normally Exhibiting Defect	Cause of Problem	Immediate Corrective Action: Preferred	Immediate Corrective Action: Alternative	Major Improvements Needed
B. Voids occurring normally just beneath outer surface of jacket or insulation sometimes giving a rough or grainy surface depending on severity of problem	Moisture in material	Any construction	Humid weather and prolonged storage of feed stock in damp locations	Dry material in hopper dryer installed on extruder	Dry material in oven	Installation of hopper dryers
				Prevent moisture pick-up by: 1) Minimizing inventory during humid seasons 2) Locating storage areas in warm dry locations 3) storing materials in tightly closed containers	Re-extrusion of wet stock after regrinding to obtain nonporous construction	Investigation of other means of removing volatiles during extrusion such as vented extruders, etc.
C. Voids occurring sporadically in wall of jacket or insulation usually accompanied by chunky surface roughness	Volatiles from degraded stock in extruded section, e.g., HC1 gas from degradation of PVC	Any construction but especially a multiple conductor construction requiring a complex die design	Excessive stock temperature	Lower temperature of controlling barrel heat zones and crosshead. Decrease screen pack—fewer or coarser screens, 1-40 and 1-60 minimum screen pack recommended. Adjust screw cooling. Increase space between wire guider and die.	Decrease take-off speed and extruder RPM	Possible need for more effective temperature controls Possible need for replacing screw with one of proper design
			Extended runs without cleanouts or screen changes	For extended runs without adequate shutdowns for cleanouts maintain stock temperature under 380°F. Provide for screen change at least every eight hours.		
			Poor streamlining or flow in approach and crosshead.	Decrease crosshead temperature but maintain die temperature 10-15°F hotter than stock as it comes out die.		Redesign dies, guiders, breaker plates and approaches with smooth angles and good streamlining
			Dirty or pitted dies, guiders and breaker plates	Maintain dies, guiders, breaker plates and approach so they are clean, highly polished, and free from rust, pits, burrs, and any build-up.		
			Improper start-up and shutdown procedures	Standardize start-up, shutdown, and clean out procedures to provide: 1) Adequate bleeding before beginning new run 2) Continuous bleeding at low RPM, with screw cooling water turned off and barrel heats decreased during temporary shutdowns 3) Sufficient flushing of barrel with head open before shutting down for extended periods 4) Proper clean up of tools while still warm. Tools and dies should never be burned out to clean		
D. Large blisters or bubbles in insulation	Volatiles carried into the crosshead by marker thread or conductor	Construction using stranded conductors and/or marker threads	Moist or oily conductor	Clean, wipe, and preheat the conductor. See IA.		

				dies should never be burned out to clean		
D. Large blisters or bubbles in insulation	Volatiles carried into the crosshead by marker thread or conductor which are trapped by the extruded PVC and expand upon leaving the die to give blisters	Construction using stranded conductors and/or marker threads	Moist or oily conductor	Clean, wipe, and preheat the conductor. See IA.		
			Conductor with a loose strand	Check stranding of wire to be sure it is tight and uniform		Improve and clean up stranding operation
			Wet marker thread	Preheat marker thread in oven or dry by passing it over heat lamp while running		
III SURFACE DEFECTS						
A. Fine pimples similar to grains of sand sprinkled over surface	Uncolloided resin particles due to inadequate shearing by the screw	Any construction in particular those with heavy walls	Inadequate screw design for low back pressure extrusions	Increase screen pack—more or finer screens	Decrease take-off speed and extruder RPM	Replace screw with shallower flight depth metering section screw
				Decrease space between wire guider and die		Extend barrel length to at least 20/1 L/D
				Use long land dies		
				Adjust screw cooling water		
				Raise temperature of controlling barrel heat zones		
B. Coarse grainy surface accompanied by porosity just under surface	Moisture in material	See IIB	See IIB	See IIB		See IIB
C. Fine grainy surface occurring over entire surface or portions of it at regular intervals	1) Material sticking to die as it leaves crosshead	Any construction	Cold, pitted, or dirty dies	Thoroughly clean die. Polish until all depressions are removed. Operate clean polished die at 15-20°F above stock temperature		Replace die and improve procedure for care and cleaning of dies and tools
	2) Strains due to elastic turbulence at high rates of flow	Peculiar to high speed extrusion	Poor streamlining and abrupt angles in approach to die	Raise stock temperature by: 1) Adjusting screw cooling 2) Raising temperature of barrel and crosshead 3) Increasing screen pack	Decrease take-off speed and extruder RPM	Lengthen approach to die. Eliminate abrupt angles and streamline die and approach. Increase land length of die.
D. Sporadic lumps of large size usually accompanied by porosity. In severe cases whole sections break down leaving craters in the surface	Degraded stock which has a consistency stiffer (higher melt viscosity) than normal PVC at extrusion temperatures	See IIC	See IIC	See IIC	Decrease take-off speed and extruder RPM	See IIC
E. Sporadic lumps and general bumpy surface. Sometimes occurs with fisheye problem	Uneven stock viscosity caused by hot and cold stock or in extreme cases fused and partially fused material	Any construction with more tendency to occur in heavier walls	Poor heat transfer to the unfused stock. Inadequate melt zone to bring stock to temperature equilibrium	See IIIA	Decrease take-off speed and extruder RPM	See IIIA
F. Sporadic lumps containing different colored or textured materials. High incidence of sparker failures	Foreign contamination in stock	Any construction	Break in screen pack. No guards on hopper. Careless handling of feed stock, or of material containers.	Flush out extruder barrel and thoroughly clean head. Avoid storing feed stock in open containers. Take care when emptying bags to keep paper out of hoppers		Install guards around hopper Place Hardware cloth over hopper opening to the extruder to prevent large objects from entering feed section of extruder
G. Raised lines on surface	Uneven die surface	Any large constructions particularly heavy wall jackets	Damage to die due to improper handling and care	Thoroughly clean die. Polish until all depressions are removed. Operate clean polished die at 15-20°F above stock temperature		Replace die and improve procedure for care and cleaning of dies and tools

H. Grooves in surface	Degradation build-up on inside of die—lumps of degraded stock too stiff to flow through the die	See IIC	See IIC	See IIC	Decrease take-off speed and extruder RPM	See IIC
I Dimples in surface	Uneven distribution of stock flow around complex shape	See IIC	See III C-2. Also guider angle may not correspond to angle of die	See III C-2	Decrease take-off speed and extruder RPM	See III C-2. Gradually change shape of guider and die to final geometry of construction from round shape of approach
J. Holes or splits in jacket	Drawdown of material exceeding elastic limit of extruded stock	Small thin-walled tubed-on jackets	Die opening too large—out of proportion for construction requiring excessive drawdown	Raise crosshead and die temperatures. Cut RPM.	Extrude insulation directly on small conductor rather than on tubing	Replace with die having smaller opening properly proportioned to desired construction dimension
IV RATE						
A. Fluctuation in rate—surging	Inadequate back pressure for screw design	See IIA	Inadequate screw design for low back pressure extrusions	See IIA	Decrease take-off speed and extruder RPM	See IIA
	Uneven feed stock temperature	Not related to construction	Hot feed stock used with no provision to keep temperature constant	Let feed stock cool to room temperature. Hold feed stock in extruder hopper to constant elevated temperature ±1°C		
	Bridging in extruder hopper	Not related to construction	Poor flow due to poor granulation or foreign contamination. Dry blend with poor flow characteristics. Poorly designed hopper and hopper throat.	Hand feed or carefully watch feeding of material. Use hopper cooling (if available). Avoid contamination.		Install agitator inside hopper or vibrator on hopper. Redesign hopper and/or hopper throat.
	Bridging in feed section of screw	Not related to construction		Maintain barrel temperature at hopper between 150-200°F. Adjust worm water to insure cool screw surface in feed section.		Polish feed section of worm.
B. Low rate	Overly high back pressure for screw design	Thin wall insulation on smaller gauge wires	High back pressure die with deep flighted screw	Decrease screen pack to minimum, normally 1-40 and 1-60. Increase space between guider and die. Increase temperature of crosshead		Redesign die and guider to give: 1) Greater difference in angle between guider and die 2) Better streamline flow 3) Larger die opening Replacement of screw with one of proper design
	Too low output from screw design	Not related to construction	High pressure screw with slow pitch or relatively shallow final flight depth — a screw designed basically for another thermoplastic	Limit screw cooling to feed section. Increase barrel heats in front sections.		Replacement of screw with one of proper design
	Worn extruder	Not related to construction	Clearances between screw and barrel too great, e.f., .040" as an extreme case. Surface of barrel smoother than surface of screw.	Polish surface of screw. Roughen surface of barrel.		Replace barrel or barrel liner. Replace screw. Replace extruder.

* Adjustments to Lower Stock Temperature
Increase space between guider and die
Decrease screen pack
Adjust screw cooling
Lower controlling barrel heat zones and crosshead temperature

** Adjustments to Increase Stock Temperature and Working
Decrease space between guider and die
Increase screen pack
Adjust screw cooling
Raise controlling barrel heat zones and crosshead temperature

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TABLE I

EFFECT OF STOCK TEMPERATURE ON INITIAL TENSILE PROPERTIES

60°C TW COMPOUND

Stock Temperature	Elongation	Tensile Strength
348°F	213%	1820 psi
350°F	214%	1840 psi
350°F	224%	1860 psi
355°F	263%	2160 psi
360°F	267%	2050 psi
360°F	275%	2090 psi
365°F	277%	2120 psi
380°F	285%	2040 psi

Running a variety of constructions on a given extruder necessarily means large differences in back pressures due to differences in size of die opening, design of approach, and speed of take-off. Inadequate back pressure contributes to surging, porosity, and other surface problems while excessive back pressure encourages hang-up and degradation. In some plants it is practical to limit to a narrow range the size of constructions extruded on a given machine to avoid the type of problems caused by wide differences in back pressure from one extrusion job to another. However, in most plants, equipment must be used for a variety of constructions. See Figure 5.

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Installation of a valve on a machine presently in operation is a possible solution but perhaps expensive or difficult to install in existing equipment. Thus, other conventional means must be used to control back pressure. Low back pressure can be increased by the use of heavier screen packs, i.e., more screens of same size or finer screens, and adjustment of guider space, the space between the wire guider and the back of the die, to a minimum distance. A minimum screen pack with a maximum guider space consistent with holding good center will decrease back pressure.

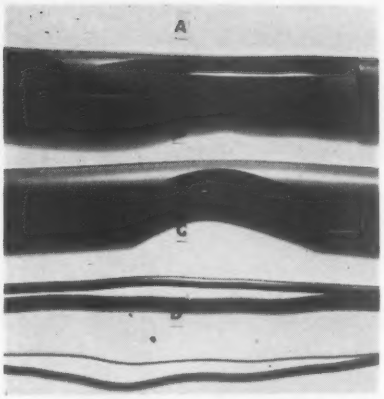

Fig. 5—Typical Vinyl Extrusions Showing Smooth Surface and Void-Free Cross Section. * * *
Spec. A—10/64" wall on #8 strand.
Spec. B—5/64" wall on #6 strand, conductor removed.
Spec. C—2/64" wall on #14 solid.
Spec. D—1/64" wall on #20 strand.

The design of the die will also affect the back pressure developed. Longer lands and parallel angles for the wire guider and die approach increase back pressure. Minimum land length dies and a wide angle between the guider and die minimize back pressure.

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Defects due to poorly streamlined die design can be minimized by adjustment of die and crosshead heats. A low crosshead temperature will minimize degradation or hang-up due to poor flow, while a high die temperature will improve the gloss of the extruded surface. In poorly streamlined designs, the widest possible guider space consistent with good centering would be recommended to enhance flow through the crosshead. (See Figures 3 and 6.)

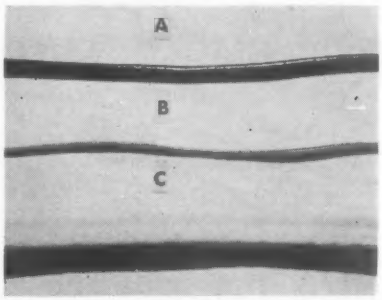

Fig. 6—Die and Approach Design—Some things to look out for. * * * * * * * * *
Spec. A—Rough Surface } Caused by dead spot
Spec. B—Groove } in flow pattern.
Spec. C—Dimpled surface due to uneven flow around guider.

Figure 7 shows a specimen of stock taken from an installation using a die adaptor with an approach angle different from the die. Close examination will show the mottled surface due to degradation of the almost stagnant stock in contact with the die adaptor, prior to the abrupt change of angle into the die. In addition, a thermocouple was placed in the die adaptor for measuring stock temperature. Lack of streamlined flow around the thermocouple, illustrated by this specimen, may not actually lead to bumpy surface or degradation, but may cause strains resulting in failures in heat aging tests.

Fig. 7—Stock Specimen Illustrating Die Shape and Stock Flow Pattern. * * * * * *

Changes in operating procedures and maintenance or care of equipment are the most straight-forward adjustments to make, but sometimes do not seem to be the most attractive solution to a given problem. Nearly every extrusion problem can be minimized by lowering the extruder RPM. However, since it is the responsibility of the production man to obtain the highest possible rate consistent with quality and cost requirements, every other approach to a solution of the problem should be exhausted before resorting to a simple reduction of RPM.

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Extended uninterrupted runs give the most economical operation of an extruder, and good maintenance procedures which minimize degradation problems are of critical importance, even though changes in well entrenched maintenance habits of operators may be difficult to accomplish. However, the best designed dies, tools and equipment give sub-standard performance if they are not properly maintained. Every pit, burr, or piece of burned stock is a starting point

for degradation. With PVC in particular, use of smooth, rust free, well cleaned and polished breaker plates, guiders, dies and die approaches is essential in maintaining streamline flow. (See Figure 4.)

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Many times complaints about extruded wire and cable are due to problems originating prior to the extrusion process. For example, contamination and porosity due to moisture are primarily caused by methods of handling the feed stock. In general, to eliminate moisture pick-up, inventories should be kept to a minimum, particularly in humid weather. When storage for long periods is necessary, the storage area should be warm and dry, and materials should be stored in closed containers. Open containers not only invite moisture pick-up but also increase the chance of foreign contamination.

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Other problem areas which give defects in the extruded product are techniques in handling the conductor and take-up equipment. Starting with a clean conductor, preheating it and passing the extruded insulation through a heated water bath will develop the ultimate properties of any insulation or jacket material. For critical constructions which must meet the latest military and aircraft specifications, such care in operation of the take-up apparatus is of primary importance.

TABLE II

EFFECT OF HOT AND COLD CONDUCTORS ON TENSILE PROPERTIES OF ORIGINAL AND AGED SAMPLES

(7 days at 100°C)

60°C TW COMPOUNDS

Material	Elongation Hot*	Elongation Cold**	Tensile Strength Hot*	Tensile Strength Cold**
A - Original	312%	212%	2690 psi	2070 psi
- Aged	218%	116%	2610 psi	2650 psi
- % Retention	70%	55%	97%	128 %
B - Original	300%	236%	2770 psi	2120 psi
- Aged	231%	143%	2940 psi	2610 psi
- % Retention	77%	58%	106 %	124 %
C - Original	322%	239%	2710 psi	2030 psi
- Aged	258%	151%	2680 psi	2580 psi
- % Retention	75%	63%	99 %	127 %

** room temperature

* 280 - 300°F

Table II presents differences in retention of elongation for a number of 60°C TW compounds extruded on hot and cold conductors. To illustrate the thermoplastic strains which are the cause of these differences, insulation was extruded on a cold conductor, stripped, and cut in equal halves—specimens A and B in Figure 8.

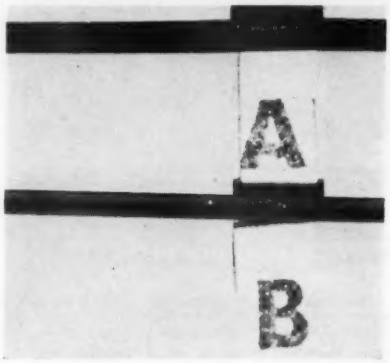

Fig. 8—Insulation Extruded on Cold Conductor.
Spec. A—Unstretched.
Spec. B—Stretched 50%.

Specimen A is unstretched while Specimen B is stretched 50%. Breaks due to strains on the inner surface next to the conductor not visible in specimen A are readily noted on specimen B. These cracks, exaggerated during aging, cut down the effective wall thickness of the insulation, causing premature tensile failures and low electrical properties. Similar effects can be shown on thin wall constructions extruded directly into a cold water bath.

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In overcoming some of the problems summarized here, it was pointed out that one of the results may be a lower rate of extrusion. Since the processing cost per 1000 feet of wire is directly affected by the wire take-off rate, the cost of any corrective action must be ascertained realistically. If the additional cost per 1000 feet is small, the change made in the operation was a good solution to the problem. If the additional cost per 1000 feet is beyond a certain point, then replacement or redesign of the equipment should be considered as most economical in the long run.

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Every firm has its own methods of computing costs, but it can be shown that the cost of operation of an extruder is pretty well fixed. Assuming a fixed cost level per hour per machine, the processing cost per 1000 feet can be easily computed. Included in the processing cost would be the equipment and plant investment, the direct and indirect labor involved in running the machine, utilities and administrative expenses in the production area. Thus, the cost of running the machine itself can be described by the following equation:

$$Y = \frac{\frac{1000}{60} C}{X} + Z$$

where Y = extrusion cost/1000 feet ($)
X = wire rate feet/minute
C = total fixed cost/hour/machine (direct and indirect including labor)
Z = variable costs such as additional power consumed, maintenance, and material handling costs which vary with the rate of speed.

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Z in comparison to

$$\frac{\frac{1000}{60} C}{X}$$

is negligible in practically all cases. For example, if at a rate of 1000 feet per minute assuming a fixed cost of $10 per hour for a given machine, then the cost per 1000

(*Please turn to page* 892)

Table III

EFFECT OF CHANGE IN RATE ON EXTRUSION COST/1000 FEET AT VARIOUS FIXED COST LEVELS

Fixed Cost Level $/Hour/ Machine	Wire Rate Ft/min.	Extrusion Cost/ 1000 Ft.	Change in Cost/1000 Feet For A 20% Rate Increase	Change in Cost/1000 Feet For A 20% Rate Decrease
2.50	500	$0.085	$-0.015	$+0.020
2.50	1500	0.040	-0.005	+0.005
10.00	500	0.330	-0.055	+0.080
10.00	1500	0.110	-0.015	+0.030
25.00	500	0.830	-0.145	+0.175
25.00	1500	0.275	-0.035	+0.075

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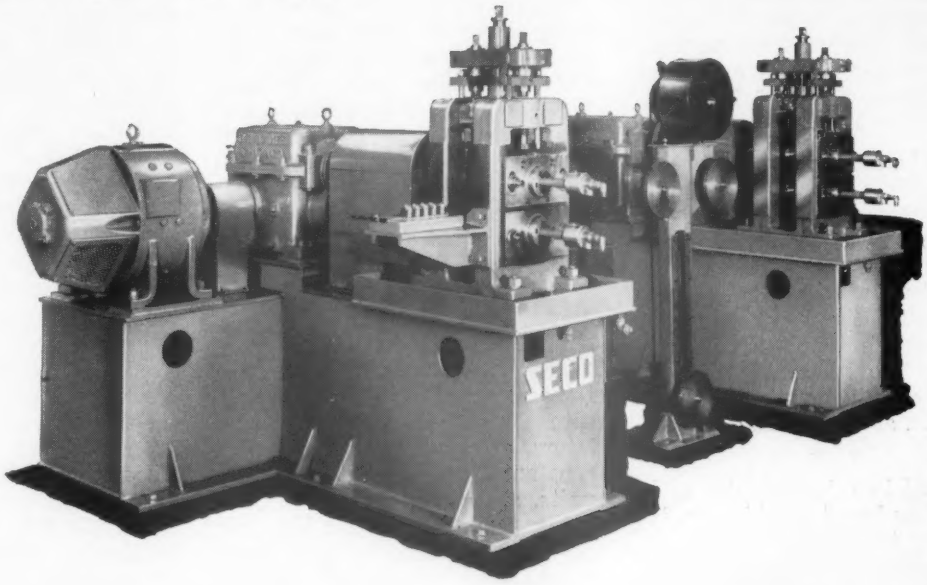

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Insulated Wire Handling Systems

by Philip C. Greene
Sales Manager, Davis-Standard
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Mystic, Connecticut

A paper presented at the Regional meeting of the Electric Wire and Cable Section of The Wire Association in Boston, Mass., on Wednesday, April 29, 1959.

There is a comment made many times in our industry which is very appropriate to this whole subject, and clearly illustrates some of the considerations we would like to discuss today. This phrase, which often comes up when a company is considering a new insulating line, runs something like this: "We want a new extrusion wire line to run everything from #22 up to 1,000 MCM."

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Frankly, such a line would be so filled with compromises that it would necessarily be inefficient on every job it was required to do. It is always necessary to have some flexibility, but the vital question in selecting the proper component equipment, is to set a reasonable limit on the smallest and largest wire sizes to be handled, as well as minimum and maximum speeds.

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To deal in a few minutes with a subject as broad as this one, it is necesary to establish a few general categories into which most insulating or jacketing work will fall; and then explain the type of item and its function, which we have found most effective to get the job done. At first glance, the type of insulation would seem to call for the two categories of plastic and rubber insulating work. However, in reality we find that most of the principles of operation, and even actual components in the extrusion line, are common to both plastic, rubber and continuous vulcanizing work.

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It was finally concluded that to best organize this presentation, all jobs would fall in a general way into either small wire at high speeds with light tensions, or large cable work at slow speeds and heavy tensions. We can consider first plastic insulating, and then rubber or CV work in each of the two categories.

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Regardless of the type of work being done, in either case, there are certain basic equipment items which must be included in some form in order to operate. These are the pay-off, the extruder with crosshead and drive, the cooling trough, or vulcanizing tube, the pulling capstan with its drive, and finally the take-up. Each piece of equipment is available in a variety of sizes and operating designs to fit its primary function. In addition to these basic items, there are many others which can be included for some special purpose, such as catenary or loop controls, accumulators, or dancer columns, tension capstans, wire preheaters, tractor units, cable guides, measuring machines, and the like. As time goes on, some of these "extras" which were once considered optional accessories, have now become basic necessities to many companies. They can pay for themselves in short order with their resulting savings from less scrap, longer runs, and better quality.

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Let's begin specifically with a small wire, high speed line which might typically be used in the insulating of individual conductor telephone wires from #19 AWG to #26 AWG. Anyone doing this work is looking for specialized equipment to give long, continuous runs at the maximum speeds possible. Some of the lines which have been in operation for two or three years are running at 1500 FPM, which is probably about the minimum profitable speed. Recently, some companies have installed new, more highly developed equipment, so that they are running consistently at 3000 FPM. The goal seems to be to reach 4000-5000 FPM, so that the extrusion line can keep pace with a wire drawing machine set up in line with it. To reach these speeds of 3000 FPM and higher, of course every piece of equipment has to be highly developed for this specific purpose, and I am sure you can realize immediately that such a machine will be relatively inflexible as far as running a range of wire sizes is concerned.

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The pay-off for accomplishing these speeds with solid wire should be a dual stationary reel type with the wire pulled off over the flange. Preferably the reels should be for horizontal operation to eliminate the hazard of loose wraps of wire dropping and causing a break. The two main advantages of this type of pay-off are the very low tensions attainable, and the ability to provide supply reels with an "inside end out" which can be welded to the next reel for continuous operation. A small, properly designed, rotating reel pay-off with good braking characteristics is normally limited to about 2000 FPM depending on reel weight and wire strength, but this type lacks the advantage of continuous feeding at high speeds. The rotating reel pay-off is suited for stranded wire work where the stationary reel type can not be used, due to putting one twist in the wire for each convolution from the reel. Following the pay-off there is normally a preheater used. The resistance type offers the advantage over a gas flame type of being able to more closely control the amount of heat imput by adjustment of the transformer to a specific voltage setting for a given wire size and speed.

The extruder for this line should be a 2½" high capacity machine capable of delivering up to 200 lbs/hr output. In order to accomplish this it must have high capacity gearing capable of continuously carrying the minimum 30 H.P. required at screw speeds of 150 to 200 RPM. The thrust capacity also must be substantial, and designed to operate at these high speeds with pressures ranging from 5,000 to 10,000 PSI. No valved head would be necessary with the inherent high die pressure. Adequate cooling capacity on the cylinder must be available to control frictional heat build up accompanying these high speeds and high horsepowers. The head clamp must also be designed to operate at high pressures on low viscosity materials without leakage.

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As for the drive on the extruder, this should be a constant torque type with a minimum of 30 H.P., and in some cases up to 40 H.P., depending on the output desired and the material to be extruded. The extruder drive should be electronically coordinated with the captan drive to allow the operator to bring both units up to operating speed, maintaining a set speed relationship. This also gives him the opportunity to slow down if necessary, and hold diameter during the speed change.

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A water trough of 30 to 40 feet in length is necessary, depending on top speed, insulation thickness, and temperature of the water itself, as well as of the conductor and its insulation.

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A small, dual, water cooled capstan with dynamically balanced sheaves and one tilted sheave for true wire fleet will best handle small wire at these high speeds. Groove diameters must be accurately machined, and flat rather than round bottom shape. Special attention must also be given to a proper air wiper under these conditions. To be ready for speeds in excess of 3000 FPM, the capstan should be driven by a 5 H.P. drive, and as mentioned previously, coordinated with the extruder drive.

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After passing through a spark tester, the wire must be clocked on a measuring machine, with a tied-in predetermining, automatic reset counter. With over one million feet to be measured in one eight hour shift, special care must be taken to insure reasonable life for the measuring machine wheels. In fact, if the line is highly specialized for very high speeds and will run only certain known wire diameters, then there is an advantage of counting the revolutions of the capstan drums to measure footage; and eliminate the need for the measuring machine. However, if product diameters vary considerably, then the footage count will vary with each new wire pitch line, and make accurate calculation difficult.

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The last item in the line, and one of the most important, is the high speed dual reel take-up. This is the component which, up until very recently, has been the speed limiting factor. Outside of a few isolated cases, most companies with whom the writer is familiar, are operating below 3000 FPM, and closer to 2000 FPM, mainly because of take-up limitations. In addition to this unit, of course, many have had other speed limiting factors, such as the type or condition of the reels generally in use today. They were not designed originally, nor have they been properly maintained to be put into use at the high revolutions required by such speeds. Other limitations to high speed in much of the existing equipment are such things as an extruder which is too small or underpowered for the outputs required, short cooling troughs, underpowered capstans which lack proper balance, and so on.

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To attain highest speeds possible now, we are convinced that the dual take-up must have two motor drives—one for each reel; and that the empty reel must be turning at wire speed before the crossover. This operation dictates a good snagger design, and a device to insure that the wire crosses both snaggers in a small fraction of a second. The whole unit must be rugged and have center supports for the reels, properly designed accumulators, and a highly developed electrical drive.

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With the latest equipment now available, speeds of at least 3000 FPM have been proven as completely practical, and such items as the take-up are fully capable of 4000 FPM. However, such rates are only being pioneered at present, and many new considerations are involved such as the tip and die design, and the resin itself. It appears that the compounds will have to be evaluated as to their ability to be forced through such small die openings at high pressures and rates, and still give the physical and electrical qualities required.

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Moving on from this typical high speed insulating line, to the more common lines for intermediate wire sizes at somewhat slower speeds, we find that many of the wire handling problems become somewhat easier. A wire line for the popular building wire sizes has most of the same considerations involved, but in most cases to a less critical degree. Here the pay-off may be of the same dual stationary reel type for the solid conductors in #12 and 14 AWG. An alternate method which has considerable merit however, is to use a relatively large supply package on a rotating reel pay-off stand. In this case both solid and stranded conductors can be accommodated, and long runs are possible before it is necessary to shut down for reel change.

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Top speeds today for this type of work are in the range of from 1500 to 2000 FPM and are normally accomplished on a 4½" extruder, which is now capable of outputs in the 500 to 600 pound per hour range. A cooling trough for this work should be at least 60 feet long, and in some cases longer. The capstan requirements are similar to those of fine wire, and should be a dual type enclosed for water cooling. The capstan drums must be larger, for example

32" in diameter, with as many grooves as the maximum wire size will allow. With seven or eight small, flat bottom grooves in each drum, which gives as much as 150 feet of capstan cooling capacity, which would otherwise have to be done in a trough, and consume more floor space.

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The take-up is normally a dual reel type, with many features similar to the small high speed unit. In fact, where a unit can be used exclusively for these small building wire sizes, and speeds of 2000 FPM and higher can be utilized, then the take-up must have most of the same design features as described for the smaller high speed stand.

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For these first two types of wire lines thus far described, the individual items of equipment have varied some in size, speed, or capacity, but essentially their operating concepts are the same. The main concern has been for attaining high speeds, and running long, continuous runs with light tensions.

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As the wire product gets larger through the intermediate size range, there is not too much change in the equipment, except that the size goes up. The supply reels are now commonly in the 42", 48", 60" or even 72" sizes. The pay-off stands are now all the rotating type, and a shaftless construction makes the loading and unloading operation much easier.

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A braking device is most commonly used, on a pay-off and if it is a good one, it seems to adequately serve the purpose in many plants. However, regardless of how good the brake is, there are bound to be momentary changes in tension, due to uneven wire lay, unbalanced reels, crossovers, etc. To eliminate the effect of these variables on the wire speed passing through the crosshead and the change in insulation thickness, an increasing number of wire lines for larger wire and cable sizes are now being equipped with a driven pay-off and a catenary control unit or accumulator to regulate the speed at which the pay-off reel is driven. For such wire sizes as #6 AWG up into the "aught" sizes, an accumulator, with 24" diameter sheaves, for example, can offer three important functions. First, the moving sheaves can actuate a potentiometer and regulate the speed of the motor drive on the pay-off. Secondly, the desired tension for each wire size can be set and maintained. And finally, the wire storage will permit continuous running, by making a splice and changing over to the second pay-off reel.

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On heavy wire or cable which can not be strung up around an accumulator, a catenary or loop control with a roller riding on the cable, can be used for supplying the regulating speed signal to the pay-off motor drive, to maintain a loop in the wire and keep uniform light tension.

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Either of these devices can similarly be used in conjunction with the driven take-up at the other end of the line. With such equipment you have an ideal condition in that you completely isolate any of the speed or tension changes due to reels from the actual insulating operation. For very high quality work where extremely close tolerances are required, such equipment is essential.

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A good example of a wire construction where such equipment would apply is the polyethylene insulated power cable with a wall thickness of 400 mils. For this work, in addition to the desirability of isolating pay-off and take-up variables, there is also a need for not only uniform tension, but for high tension sufficient to minimize the catenary through the long length of staged cooling trough required. This will keep the cable from dragging on the bottom of the trough in the initial hot water section, much as is necessary on a horizontal continuous vulcanizing line, and thereby preventing flattening or scuffing of the insulation before it is set.

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To best accomplish this, two caterpillar capstans are used; one just before the extruder and the other at the far end of the cooling trough. The back caterpillar can be the speed control capstan which is coordinated electrically with the extruder drive, so that both maintain a fixed speed relationship. The final caterpillar is essentially a tension drive, and if an AC-DC system is employed, this last drive would be a current regulated type. There is a tachometer generator signal tie in between the two capstans, but its purpose is only to signal that a speed change is occurring so that the final pulling caterpillar can anticipate this change before it results in a momentary tension change.

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Caterpillar capstans, as described, are ideal for handling large cable which should not be flexed around a capstan drum. The two main reasons for not using such capstans more universally are that they are limited in speed to approximately 50 FPM, and they lack all the added cooling capacity which the dual, water cooled capstan offers. As a general rule on a 48" dual capstan, we have found it very successful up into the circular mil sizes of about one inch diameter stranded conductor. With more flexible cables, larger sizes can be efficiently handled on the 48" dual.

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Up to this point we have considered only plastic insulating lines, and have tried briefly to point out some of the more important features which we feel contribute most to good operation for a particular range of wire sizes. As we turn to the wire handling systems for rubber insulation, we find that a majority of the principles discussed for plastics will also hold true on similar sizes of rubber wire, so it should only be necessary here to cover points which differ for the two types of material.

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With rubber insulating we find the general difference that maximum wire speeds are substantially slower. In a few cases speeds close to 1000 FPM have been run with small wire on a CV line, but normally they are considerably

slower than this. The limitation, of course, is the time required to properly cure the material in the steam tube. This means that the high speed take-up, for example, would not have any real purpose in the rubber work.

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For CV applications the vast majority of the lines use either a 3½" or 4½" extruder, with only a few 6" machines used for special reasons. Most companies are feeding room temperature rubber to the machine, and longer length over diameter ratios than those of the old hot rubber machines have an advantage. Lengths of from 9:1 up to 15:1 are in successful service, with approximately the mid point appearing to be the optimum length. An increasing number of rubber extruders recently have been electrically heated, however, the majority are still of the conventional jacketed type.

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Most continuous vulcanizing lines operate with 250 PSI steam in the curing tube, with a few lines at 300 PSI. Actual lengths of tube run from as little as 120 feet up to better than 200 feet, plus another 10 to 20 per cent of pressure cooling leg.

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One of the major concerns in design of CV equipment is to prevent the wire from rubbing on the tube until it has travelled a sufficient distance in the steam to effect a partial cure. Hitting the tube before this point will result in damage to the uncured insulation. This means that good tension control is essential, and it can best be attained with the use of two capstans. The actual number of pounds pull suitable for an operation, will range from a few pounds on light wire up to approximately 1500 pounds on some of the circular mil sizes. This value will be dependent too on the size of curing tube, and on the angle from the horizontal at which the first few tube lengths have been designed. You could get by with a completely horizontal crosshead and vulcanizing tube if only very small wire will be run, however, we know that even here there has to be some catenary or "droop" to the wire over these long lengths, and recommend all lines have at least a 1° decline to the initial lengths of curing pipe.

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For strictly small wire work, a typical CV line would incorporate either no back tension capstan at all, or one which is driven forward at the coordinated and regulated speed to maintain a light wire tension. Otherwise the inertia of such a unit itself, even with its braking device inoperative, can either cause drawn down in the conductor, or cause the wire to scuff on the top of a pitched curing tube. Next in line would be a 3½" rubber extruder with an adjustable center crosshead, and pressure roller feed. The splice box and first two sections of vulcanizing tube will normally be 4" I.D. and set at a 1° decline.

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The rest of the tube can be horizontal, and of smaller size, to consume less steam capacity. Next is the steam seal to separate the steam from the pressure water cooling leg, with a similar water seal at the far end to hold water pressures, which range from 60 PSI up to full steam pressure. On fine wire with thin insulations or jackets and no filler materials in the construction, such as cotton, or jute, the water leg can be fairly short, say as little as one-tenth of the curing length. With small wire it is sometimes practical to reverse direction after the water seal and return through a cooling trough back to the pulling capstan at the extruder end.

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For making wire in the range of from #14 up to 500,000 CM, then a back drag capstan should go up to a 48" diameter, and a 4½" extruder would be required. By going to 6" I.D. curing tube set at a 3°, 2° or 1° pitch, the larger sizes can be properly accommodated. For such work, a longer pressure cooling leg in the order of 20% of the total tube length, will be needed. Also we believe it is now very important that the pulling capstan be located at the end of the water leg. In this way you have a "straight line pull" between the two capstans to more easily get up to and accurately hold the high tensions required to prevent scuffing in the tube. Even with such an arrangement and high tensions, we know that the cable will be dragging along the bottom of the tube for much of its distance. However, by preventing this contact until the cable has travelled some 20 to 30 feet from the head, an adequate "skin cure" will protect the insulation from any damage.

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If the bulk of the wire or cable to be run is larger than 500,000 CM, then there are two other alternate systems to consider. Again, this will depend partly on whether there will be reasonably long runs to warrant CV work, and whether some size will get up above the 3" diameter. For extremely large sizes, or short lengths, then a pan curing or drum curing line would be called for. Here a double caterpillar line with soft capstan treads and low tensions so that the tread squeeze can be kept at a minimum, will give excellent performance.

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For longer runs and sizes in the 1" to 3" range, or particularly where high voltage, heavy wall butyl cable must be handled, then the recently developed vertical CV line comes into its own. We have eight such lines now in operation, and doing an excellent job on heavy wire constructions which heretofore have been impossible with a CV installation.

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The principle of a vertical CV is to have the extruder and speed control capstan installed high enough in the building to allow at least a partial, self-protecting cure for the insulated cable while moving vertically. This completely eliminates the scuffing problem. On heavy wall butyl insulations for high voltage applications, this vertical run for the initial cure also prevents the butyl from sagging out-of-round or off-center. There are many original and unique con-

(*Please turn to page* 883)

Induction Heating System for Thermoplastic Extrusion

by

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Screw Extrusion Equipment

and

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George E. Carle

This paper was presented at the Regional Meeting of the Electric Wire & Cable Section of The Wire Association in Boston, Mass., on April 29, 1959.

Mr. Carle, a graduate of the New Haven College of Engineering, is a Professional Engineer—State of Connecticut.

Mr. Hold, a graduate of the University of Vienna, is a Dr. Eng.-Mech. Eng. and Eng. Physics. In addition to research and engineering work in Germany and Canada, he was for a time Associate Professor of Mechanical Engineering at McGill University in Montreal.

Peter Hold

Successful processing of a plastic material in an extruder depends largely upon the control of the material temperature within the various zones of the extruder chamber. This is being achieved by proper proportioning of the screw and the barrel assisted by a control of the temperature of the inner wall and, if necessary, of the screw surface. It is obvious that the closer we bring the sources of heat and cooling to the inner surface, the better we will succeed in maintaining a set surface temperature. Only a system with small time lag between source and controlled area is capable of following sudden changes, thus keeping the controlled temperature within a small band width.

* * *

Among all the presently used heating systems, Induction Heating, in this respect, takes a superior position. As we will see later, Induction Heating with low frequency (60 cycles) generates the heat directly in the wall of the barrel fairly uniformly distributed. Furthermore, it permits the introduction of any cooling medium, liquid or gaseous, directly to the outer surface of the extruder body because adequate space can be provided between this surface and the primary coils of the induction heating system.

* * *

First of all, we shall discuss briefly the basic principle of Induction Heating. Figure 1 shows schematically the arrangement of an Induction Heating unit of an extruder. The primary coils are wound around the extruder body with sufficient radial clearance to provide space for a cooling medium. Magnetic core segments insuring minimum resistance to the magnetic flow are, therefore, essential for a high efficiency of the heating system, as we will see later on.

* * *

Figure 2 shows a photograph of such an Induction Heating system applied to an Inductomatic Extruder.

* * *

Figure 1—The A.C. current in the primary coils, which in our case has a frequency of 60 cycles, produces a magnetic flux Ø with a

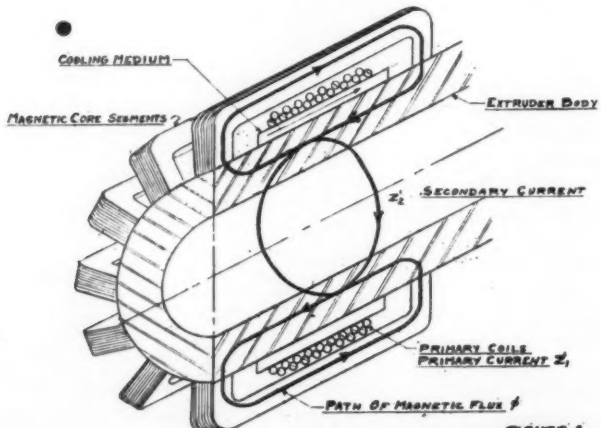


FIGURE 1

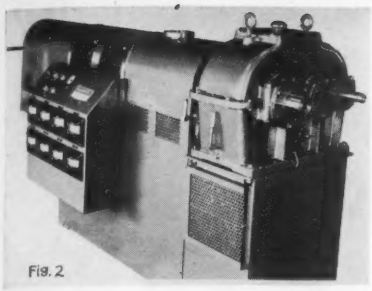


Fig. 2

path as shown in Figure 1. The magnetic loop is closed by the laminated core segments made from material with high permeability, thus providing a minimum resistance to the magnetic flux. In order to get a better understanding of the condition, we change to Figure 3 and consider for a moment the tubular extruder body to be slit as shown in the picture. The magnetic flux which alternates with the same frequency as the primary current induces a voltage e_2 which we could measure across the two opposite surfaces of the longitudinal slot. The magnitude of this voltage is given the expression in Figure 3. If we close this circuit now, the secondary voltage produces a secondary current i_2. With an ohm resistance R_m along the mean circular path, the heat generated in the body is given by the following expression:

$$\text{(Watts)}\quad W = i^2_2 \times R_m$$

* * *

The induction heating unit can, therefore, be described best as: A short circuited transformer with a single secondary coil. The extruder body functions as secondary coil and at the same as part of the magnetic core. The flux induces also a voltage in the core segments, but owing to the fact that these are properly laminated, no current can flow. Such a current flow would be a loss because this heat would contribute very little to the heating of the cylinder wall.

* * *

Our next question concerns the amount of heat or the power density which we have to produce inside the material. A very approximate calculation of the heat generated by the magnetic flux results in the expression given in Figure 3. For the derivation of this formula, it was assumed that the induced voltage is constant over the whole cross section and the variable path resistance was replaced by a mean value. On the other hand, we know that it takes 0.60 watts per cubic inch of material (steel) to raise its temperature for 1°F per minute. If we decide on the rate of temperature rise, we can immediately determine the required power. For a rate of 20° per minute which is a good average value we need, for instance, 12 watts per in^3. This value enables us to calculate the required flux density Bmax with the help of expression for W^1 given in Figure 3. All other quantities are given, ρ the resistivity of the cylinder material, d/D, the dimensions of the cylinder, and "f" the net frequency of 60 cycles per second. The flux density Bmax for steel is limited. If the material reaches saturation, a further increase in magnetizing force does not result in an increase in flux density.

* * *

Figure 4 shows a normal magnetization curve for steel. Fortunately, the flux densities "B" which we need to satisfy our power requirements are well below the saturation limit for the machine sizes which we are dealing with.

* * *

At this moment it seems to be timely to mention the temperature limitation of our Induction Heating unit. The above magnetization curve is not valid anymore at temperatures above approximately 1400°F (Curie Point). The permeability of the steel becomes unity and steel behaves as far as its magnetic properties are concerned like air. Induction heating is still possible beyond this point, but it takes a much greater magnetizing force, or in other words, much more ampere coils for the same flux density. The losses in this paramagnetic region are, therefore, much higher than in the ferromagnetic region in which we work. Many of the applications of induction heating work at least partially in this range, and at high frequencies. For instance, heating of material to be forged, surface hardening, etc. Therefore, the relatively low efficiency experienced in these applications is commonly associated with Induction Heating. It is, therefore, important to realize that in our case with low flux density, the efficiency is excellent

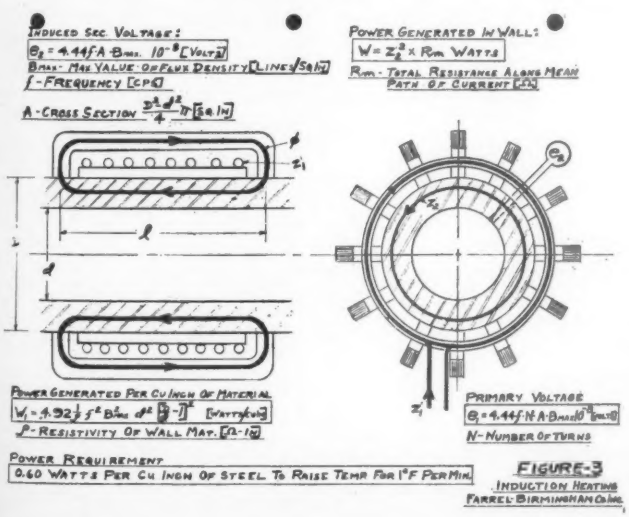
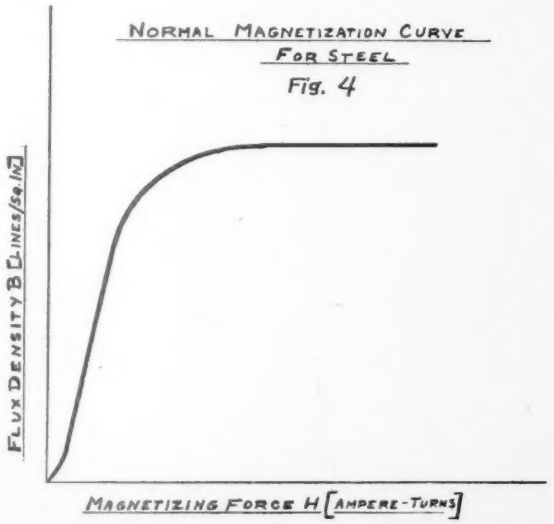
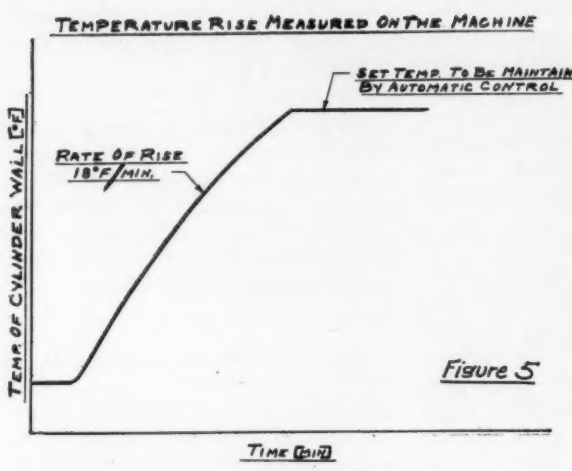
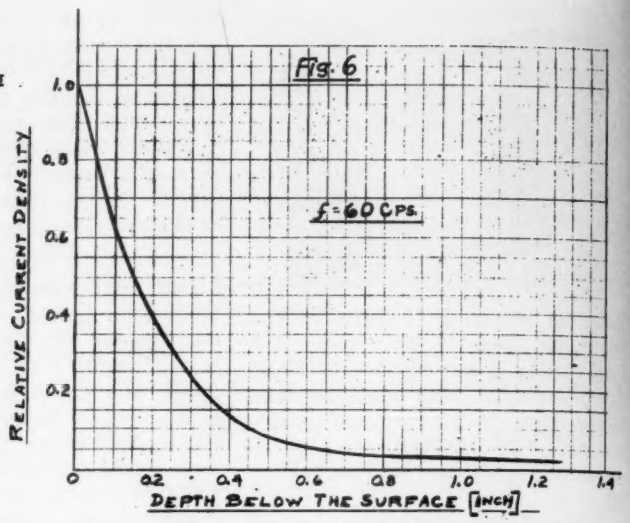

INDUCED SEC. VOLTAGE:
$E_2 = 4.44 f A B_{max} 10^{-8}$ [VOLTS]
B_{max} - MAX VALUE OF FLUX DENSITY [LINES/SQ IN]
f - FREQUENCY [CPS]
A - CROSS SECTION $\frac{\pi}{4}(d^2 - d^2)$ [SQ IN]
POWER GENERATED IN WALL:
$W = I^2_2 \times R_m$ WATTS
R_m - TOTAL RESISTANCE ALONG MEAN PATH OF CURRENT [Ω]
POWER GENERATED PER CU INCH OF MATERIAL
$W_1 = 4.32 \frac{1}{\rho} f^2 B^2_{max} d^2 \left(\frac{D}{d} - 1\right)$ [WATTS/CU IN]
ρ - RESISTIVITY OF WALL MAT. [Ω-IN]
POWER REQUIREMENT
0.60 WATTS PER CU INCH OF STEEL TO RAISE TEMP FOR 1°F PER MIN.
PRIMARY VOLTAGE
$E_1 = 4.44 f N A B_{max} 10^{-8}$ [VOLTS]
N - NUMBER OF TURNS

FIGURE-3
INDUCTION HEATING
FARREL-BIRMINGHAM CO. INC.




TEMPERATURE RISE MEASURED ON THE MACHINE
SET TEMP. TO BE MAINTAINED BY AUTOMATIC CONTROL
RATE OF RISE 18°F/MIN.
TEMP OF CYLINDER WALL [°F]
TIME [MIN]
Figure 5



if the system is properly engineered, and it is furthermore important to note that we have a possible temperature range within the ferromagnetic region up to well above 1000°F.

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Figure 5 shows a temperature time curve which was actually measured during the heat up period. In this case, the rate of rise was approximately 18 °F/Min. After the control shuts the power off, there is hardly any further increase because the temperature is being raised fairly uniformly throughout the wall. For the very same reason, we can also afford to raise the temperature at a higher rate than with a system using a heat source at the O.D. of the cylinder because we do not introduce high thermal stresses.

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So far we assumed the current distribution to be fairly uniform throughout the wall. This is, however, only correct within certain limits. In Figure 6 is shown the relative current density versus the depth below the surface for a frequency of 60 cps. The current has its maximum value at the surface and dies off exponentially below the surface. Up to a wall thickness of ½", the method of calculation which we discussed above, and which applies to mean values of resistance and current, is fairly accurate. Above this dimension, we have to refine our method and take the so-called skin effect into account. Up to walls of 1-½ or 2" thickness, the low frequency induction heating is far superior to any method applying the heat to the surface of the cylinder. In the case of contact heaters, all the heat has to be conducted through the wall, and in addition the resistance to the flow from the heating medium to the cylinder has to be overcome. The area under the curve is a rough measure for the generated heat. In the case of clamp on heaters, all the heat will have to come from the outside.

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In order to make our description of the induction heating unit complete, we also have to consider the function and dimensioning of the primary coil. We refer back to Figure 3. From our past discussion, we have learned that it takes a certain magnetic flux and therefore a certain flux density to generate the amount of power in the cylinder wall which is needed to give a certain rate of temperature rise.

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We consider now the induction heating unit again as a transformer and for a moment we assume, as we did before, that the cylinder wall, which represents the secondary coil of this transformer, has a longitudinal slot so that no secondary current i_2 can flow. The variation of the magnetic flux will then produce a voltage e_2 across this slot as we discussed before. However, in order to produce this magnetic flux, it takes a certain magnetizing force which has to be provided by the primary coil. (See left side of Figure 3.) We express this magnetizing force in ampere turns, that is, the product of the magnetizing current flowing in the primary coil times the number of turns. Any combination of current and number of coils which give the same product represents the same magnetizing force. However, if we had already made a decision regarding the primary operating voltage of our heating system, say, for instance, 240 volts, then the number of turns of the primary coil is already determined. As we can see from the expression for the primary voltage in Figure 3, the primary voltage which the magnetic flux induces is given by the same formula as the secondary voltage, the only difference being that we have to introduce the number of turns "N" whereas in the case of the secondary voltage this quantity was unity. If we now close the fictitious gap in the wall of the cylinder, the current i_2 which generates the required heat will flow around its circular path, and in order to maintain the magnetic flux, we observe an additional current in the primary coil. According to the theory of transformers, the ratio between these two currents is approximately given by the number of turns of the primary coil.

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It would lead us too far to go any further into the theory of transformers, but anyone familiar with transformer vector diagrams is in a position to determine the total primary current, the power factor, and the losses. We remember that

(*Please turn to page* 889)

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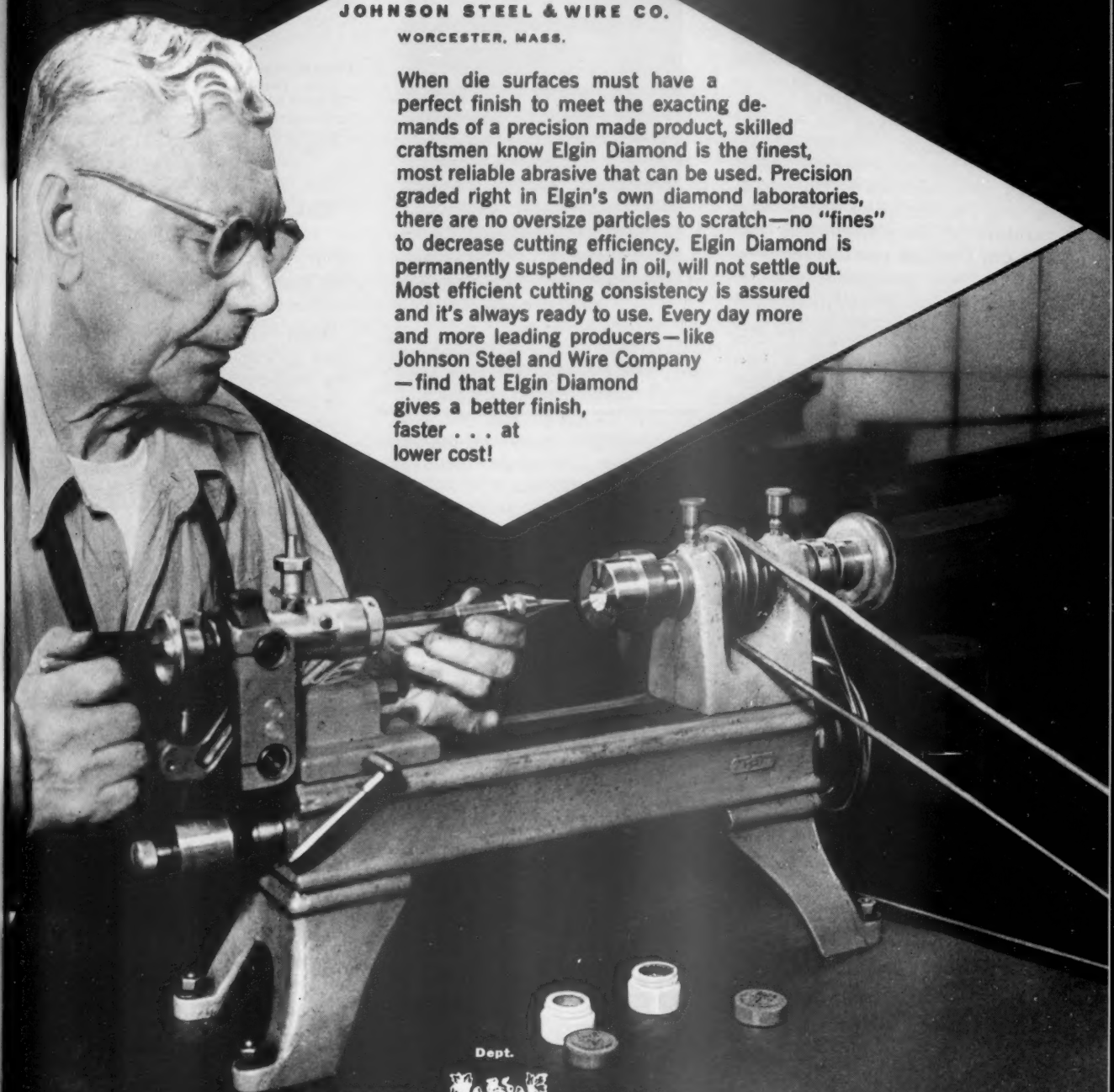

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ABRASIVES DIVISION

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The Processing of Chemically Thermosetting Polyethylene

by Arthur C. Rowley
Sales Representative
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Introduction

During the past year and a half, the wire and cable industry has shown a rapidly growing interest in a class of compounds based on polyethylene which may be thermoset (or "cross-linked," or "cured," or "vulcanized") through the agency of peroxides which have reaction temperatures that are higher than the fluxing or mixing temperature of the polyethylene. Because of the high reaction temperatures, these peroxides may be mixed with the polyethylene compound, which subsequently may be formed into useful products, after which a further elevation of temperature results in the thermosetting reaction. Thus, a new family of materials is made available for manufacture on typical rubber processing equipment.

★ ★ ★

This thermoset polyethylene has a number of important advantages over thermoplastic polyethylene and other thermoplastic materials, namely:

1. **Because of its three-dimensional molecular structure, it does not develop a high degree of crystallinity; therefore, it may be heavily loaded with fillers without embrittlement thus greatly reducing compound cost and modifying its processing characteristics and physical properties.**
2. **Another result of its lack of crystallinity is freedom from environmental stress cracking and loss of physical properties in weathering.**
3. **At elevated temperature it does not lose all strength and exhibit flow under light loads. Its physical properties at high temperatures are similiar to those of other vulcanized elastomers.**
4. **Resistance to chemicals and solvents is generally superior.**

★ ★ ★

The thermoset compounds possess many of the desirable properties of thermoplastic polyethylene, including good low temperature impact resistance and outstanding electricals, especially resistivity. Physical properties are very similar except that the filler-loaded thermoset polyethylene does not draw to the high elongations that are typical of conventional polyethylene. Abrasion resistance of thermoset polyethylene stocks is generally superior to that of the thermoplastic resins from which they are derived.

Arthur C. Rowley

The author presented this paper at the Regional Meeting of the Electric Wire and Cable Section of The Wire Association in Boston, Mass., on April 29, 1959.

★ ★ ★

The art of compounding polyethylene materials of the thermosetting type is at a very early stage, and, at present, it is necessary to observe rather narrow ranges of working temperatures. It is the purpose of this paper to outline the principles involved in practical processing of these compounds as they are now known to the wire and cable industry.

Processing Temperatures

Most commercial black-filled compounds being studied by the wire and cable industry to date are formulated with the following components:

	Parts by Weight
Polyethylene Resin, Low Density	100
THERMAX®	50-400
Antioxidant	0.5-2.0
Peroxide Curing Agent (100% Active Basis)	1.75-2.5

★ ★ ★

The dosage of black appearing to give optimum properties for drop wire insulation is in the range of 80 to 100 parts.

★ ★ ★

Most antioxidants inhibit the cure to varying degrees by reacting preferentially with the peroxide curing agent. Two types which show a negligible adverse effect on cure are (1) polymerized trimethyl dihydroquinoline* and (2) sym. di-B-naphthyl para-phenylenediamine**; their use is recommended where elevated service temperatures are to be encountered.

★ ★ ★

The peroxide curing agents are available in 100% active forms or in combination with inert carriers, and their dosages must be adjusted accordingly.

★ ★ ★

The type of polyethylene used determines, by its softening temperature, the lower limit of the processing range, in this case about 230°F. The type of peroxide, by its thermal decomposition properties, determines the upper temperature limit of processability which will avoid premature reaction or "scorch." With present curing agents, this upper processing limit is about 310°F. Thus, in the type of stock under discussion, the proc-

* Agerite Resin D®
** Agerite White®

essing temperatures of a fully compounded material must be held between 230°F. and 310°F., a fairly narrow range as may be judged by those experienced in rubber technology.

★ ★ ★

Two primary equipment requirements for successful handling of thermosetting polyethylene are, therefore, (1) accurate temperature instrumentation in all parts of the equipment that must hold or move the material in its plastic state, and (2) efficient control of temperature of the material at these points.

★ ★ ★

In the use of internal mixers, accurate temperature measurements are the rule in most plants and present instrumentation is usually adequate for mixing these polyethylene compounds.

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As to temperature control, some modification of most internal rubber mixers may be needed to allow use of low pressure steam or hot water interchangeably with cold water.

★ ★ ★

A typical mixing procedure where steam or hot water is **not** available involves preheating the Banbury prior to the first polyethylene batch with a hot rubber prebreak, with cooling water shut off. Immediately thereafter the resin and filler are added and allowed to come to fluxing temperature by frictional heat. This may require 10 to 15 minutes, depending on how well the mixer is preheated. Low pressure steam for preheating the Banbury would reduce the time to reach fluxing temperature and eliminate the need for a high temperature prebreak.

★ ★ ★

The batch, which fluxes at about 230°F. to 240°F., requires about 10 additional minutes of mixing for proper dispersion of the black and will continue to rise in temperature unless there is very effective cooling available in the machine. It is inadvisable to add the peroxide curing agent until temperature rise is brought under control. This maximum temperature is governed by the choice of peroxide. In the case of 2-5 di-tert-butyl peroxy 2-5 dimethyl hexane***, this can be as high as 290°F. It is frequently necessary to discharge the batch at the end of the mixing time without addition of the peroxide, holding it out for addition during a second, cooler mix.

★ ★ ★

It should be added at this point that it is advisable that the mixer operator keep a close watch on the machine's ammeter (or wattmeter) as the batch goes through the fluxing range since there is usually a rather large power load at this phase of the mix. This load may be kept within safe limits by manipulation of the ram to reduce pressure on the compound.

★ ★ ★

Once the batch is fluxed to a plastic mass, its viscosity drops rapidly as its temperature continues to rise, and full ram pressure may be reapplied.

★ ★ ★

In the second mix, if it is necessary, the slabbed compound crumbles readily in the mixer, and the peroxide can be added and dispersed thoroughly in the ground material while the batch rises again to fluxing temperature. Mixing after fluxing may be limited to only 3 or 4 minutes, and the batch discharged at a safe temperature.

★ ★ ★

The next item of equipment requiring accurate temperature control is the sheet-off mill below the mixer. Mill rolls should be controlled at about 200-220°F. If the rolls are too cool, the compound will stiffen, refuse to band, ride above the nip, and, at best, crumble into the pan. If the rolls are too hot, approaching the fluxing temperature of the compound (230°F. plus), the compound will tend to stick badly. The sticking problem may ultimately be overcome by using release agents either in the formula or on the rolls, but in the recipes described above, this problem must be recognized. Time of working on the sheetoff mill should be kept at a minimum to avoid excessive temperature build-up.

*** Varox, R. T. Vanderbilt Co., Inc.

Since the uncured compound is hard and quite brittle when cool, it cannot be conveniently fed to an extruder as a strip. It is usually shredded or diced and fed via a hopper. Temperature control is not needed at the granulating operation but again becomes of major importance at the extruder.

★ ★ ★

The material has been extruded successfully as insulation using both plastics and rubber machines. In general, rubber tubers of the type used for room temperature fed stocks, having extended barrels, or plastic tubers, have been found preferable to the short barrel machines. It should be stressed that regardless of what type of machine is used, accurate temperature instrumentation and control is of vital importance throughout the barrel, worm, and head.

★ ★ ★

A good rule to follow is that temperatures throughout, except at the die, should be only slightly above the fluxing temperature of the compound, between 230°F. and 250°F., and an adequate flow of conditioning medium, especially throughout the tuber head, should be available. This conditioning medium may be low pressure saturated or wet steam (**without** superheat) or hot water, at about 230°F.-240°F. Good flow of conditioning medium through the head is very important in a CV machine, in which curing steam is in contact with the extruder die, in order to prevent heat migrating from the curing section into the head, via the die, from raising the temperatures in the die block to scorch levels. (In this respect, the conditioning medium in the head is acting as a coolant.)

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At the start of a CV run, it is usually necessary to preheat the die to extrusion temperature, about 270°F., either by an electric heater or by momentarily closing the CV chamber and applying the high pressure steam. Once extrusion and curing has started, the die is adequately heated by curing steam, and CV speeds comparable to those for neoprene compounds may be attained.

There appears to be no general concensus, to date, as to the type of extruder worm to be recommended for handling thermosetting polyethylene, but whatever design is used, it should be adequately cored for the temperature control medium.

Mixing Procedures

Probably the most important quality of a compound by which the effectiveness of a mixing procedure is evaluated is its degree of dispersion. In the preparation of rubber-like materials, control testing of physical properties will normally detect inadequate dispersion of ingredients. It has been found with black-loaded thermosetting polyethylene, however, that physical properties of vulcanizates are relatively insensitive to variations in dispersion.

* * *

It is known that such variations can exist, since they result in variations in dielectric strength, and voltage breakdown failures of insulated wire have been troublesome at times to most manufacturers.

* * *

Since dielectric strength measurements on molded slabs are erratic and entail considerable experimental error, these do not constitute suitable control tests for degree of dispersion. In an experiment designed to introduce considerable variation in degree of dispersion in a series of laboratory mixes, the R. T. Vanderbilt Company evaluated these procedures by testing the resulting press cures for dielectric constant, power factor, and volume resistivity, as well as for physical properties.

* * *

The dielectric properties of S.I.C. and power factor were found to be significant measurements of degree of dispersion and have the advantage over physical tests and dielectric strength of being nondestructive to the specimens.

* * *

The compound used is shown in Table I, being a 1000 cc. volume batch in which mixing temperatures were controlled not to exceed 260°F. A laboratory "B" Banbury was used. The polyethylene and carbon black were mixed together following several procedures, to be described, and the peroxide curing agent added and mixed for 3 minutes at the end of each batch.

Table I

Base Formula - Banbury Mixed
Maximum Temperature 260°F.
1000 cc. Batch Volume

Polyethylene, Low Density	600	gm.
THERMAX ®	600	gm.
Peroxide ****	12.	gm.
Polymerized Trimethyl Di Hydroquinoline	6.0	gm.
	1218	gm.

**** 100% Active Basis.

In Table II is shown the effect of variations of mixing time of polyethylene and black. Electrical and physical tests were performed on specimens (3 per compound) molded for 20 minutes at 320°F.

* * *

These data and those to follow demonstrate that physical properties show very little effect of variation in mixing procedure, that resistivity figures do not differ enough to be considered significant, and that dielectric strength is highly erratic and undependable in molded slabs.

* * *

However, as judged by dielectric constant and per cent power factor, A-2 stock has the optimum mixing time, in this series, of 10 minutes for black and polyethylene. This mix gives properties considerably superior to those of a 5-minute mix and is as good as the 20-minute mix.

* * *

The A-2 stock data will be used in the subsequent tables for reference purposes.

* * *

Table III shows the effect of increased mixer speed over the same range of polyethylene-black mix times.

* * *

The dielectric constant and power factor again show the improved dispersion obtained through the greater energy input of the higher speed mixing. Five minutes at 120 rpm appears at least equivalent to 10 minutes at 80 rpm. Compound A-7, the 10-minute mix at 120 rpm, appears optimum for the high speed series of mixes.

* * *

In Table IV is presented the results obtained by adding black to resin prefluxed in the Banbury. The total mix times are the same, 13 minutes, and the rotor speed was constant at 80 rpm.

* * *

These data, especially of compound A-5, indicate that the black should be added early in the mix, preferably at the same time as the polyethylene.

* * *

In Table V, a variable introduced for the first time is batch volume. In all mixes, 80 rpm rotor speed

(*Please turn to page* 880)

Table II
(80 rpm Rotor Speed)

	A-1	A-2	A-3
Mix Time, Polyethylene-Black	5 Min.	10 Min.	20 Min.
Addition of Peroxide	3 Min.	3 Min.	3 Min.
Total Time	8 Min.	13 Min.	23 Min.
D.C. Resistivity, 500 V, 70°C., Ohm-Cm.	2.1×10^{13}	5.8×10^{13}	5.9×10^{13}
Dielectric Constant, 1000 cps.	13.6	11.1	11.1
% Power Factor, 1000 cps.	7.5	4.5	4.6
Dielectric Strength, V/Mil.	90	97	82
Modulus @ 100% Elongation p.s.i.	2130	2020	2170
Tensile Strength, p.s.i.	2430	2440	2410
Elongation, %	190	180	170

Table III

	A-2	A-6	A-7	A-8
Rotor Speed, rpm	80	120	120	120
Mix Time, Polyethylene-Black	10 Min.	5 Min.	10 Min.	20 Min.
Addition of Peroxide	3 Min.	3 Min.	3 Min.	3 Min.
Total Mix Time	13 Min.	8 Min.	13 Min.	23 Min.
D.C. Resistivity, 500 V, 70°C., Ohm-Cm.	5.8×10^{13}	8.9×10^{13}	7.8×10^{13}	9.6×10^{13}
Dielectric Constant, 1000 cps.	11.1	10.3	10.0	8.9
% Power Factor, 1000 cps.	4.5	4.0	3.5	3.8
Dielectric Strength, V/Mil.	97	119	121	103
Modulus @ 100% Elongation, p.s.i.	2020	2140	2120	2180
Tensile Strength, p.s.i.	2440	2420	2410	2400
Elongation, %	180	170	180	170

The Controlled Cooling of Extruded Polyethylene Insulations

by Michael M. Suba
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Union Carbide Plastics Company
Division of Union Carbide Corporation
New York, New York

Polyethylene has been successfully extruded as an insulation over electrical conductors for the past fifteen years. During this period research into fundamental extrusion theory has occupied an important position in the wire and cable industry, resulting in increased production efficiency and product quality. There is probably very little, if anything, which we can add today to the industry's "know-how" in handling wire and cable extrusions. The purpose of this paper is not to introduce an entirely new concept but to expand on an established and accepted phase of polyethylene extrusion—that having to do with its cooling after extrusion.

★ ★ ★

Polyethylene first became commercially available during World War II. Because this new material was available in limited quantities, its use was restricted to the most critical war applications. For the most part, polyethylene was initially used as an insulation in coaxial cables for high-frequency radar installations. The construction of these vital cables consisted of heavy extruded walls of polyethylene over relatively small conductors. It is probably fortunate that our first experience with polyethylene was one of the toughest types of extrusions. The successful extrusion of thick-walled primary insulations presented a challenge to the then young plastics industry and consequently many of the problems involving polyethylene extrusion were solved at this early stage; if not solved, they were at least brought to light. The first attempts at extruding these heavy walls consisted of rapidly cooling the polyethylene in accordance with the established practice employed with polyvinyl chloride. The resultant cables, however, exhibited severe corona failures which were related to voids within the insulation and between the insulation and the conductor.

Michael M. Suba

A paper presented at the Regional Meeting of the Electric Wire and Cable Section of The Wire Association in Boston, Mass., on April 30, 1959.

The author, a graduate of Rutgers University with a degree of B.S. in Chemistry, has been with Union Carbide for 25 years in various capacities. He has presented papers previously at Association meetings.

★ ★ ★

After considerable investigation, it was concluded that these voids were caused by the rapid chilling of the polyethylene and the resultant uncontrolled shrinkage of the insulation. In passing through the cold water, the outer surface of the insulation became chilled too rapidly and consequently hardened. Meanwhile as the inner portions of the insulation cooled, the shrinkage tended to be towards the outside-hardened surface and hence, voids developed both along the conductor and within the insulation itself. This condition can be more clearly understood by examining the curve plotting volume change versus temperature change (Figure 1). It will be noted that the volume of .92 density polyethylene decreases linearly with temperature change until a temperature of 230 deg. F. is reached. The greatest volume change occurs between 212 deg. F. and 230 deg. Fahrenheit. There is, however, a substantial change of volume until a temperature of 167 deg. F. is reached; beyond this point the change becomes some-

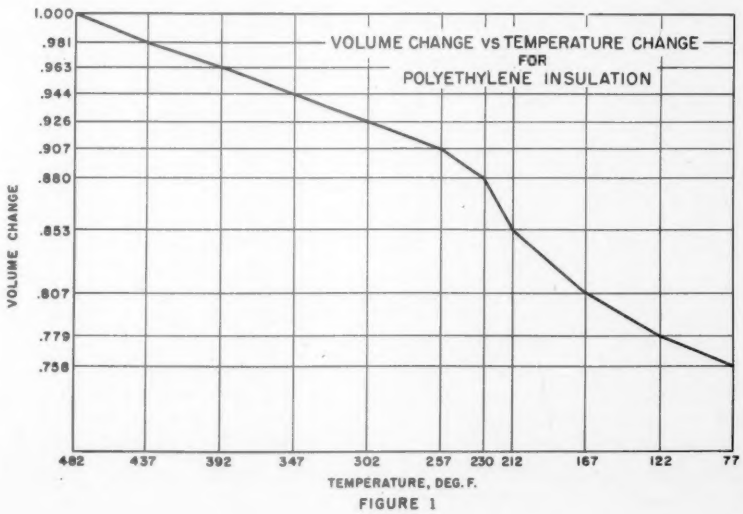

FIGURE 1

what linear once again. It is therefore apparent that controlled cooling is most significant in the temperature area of 167 deg. F. to 230 deg. Fahrenheit. The transition temperature at which .92 density polyethylene changes from a viscous liquid to a solid is in the area of 221 deg. Fahrenheit.

★ ★ ★

Considerable experimentation in controlling this shrinkage resulted in a technique referred to as gradient cooling. It was found that by passing the extruded insulation through long cooling troughs maintained at temperatures of 180, 160 and 140 deg. F. with a capstan in cold water, the cooling was sufficiently well controlled to eliminate voids. It might be conjectured that the temperature gradients serve to bring the insulation to the respective temperatures of each trough. However, theoretical considerations indicate quite conclusively that it is entirely impractical to make the troughs anywhere near long enough to accomplish this feat. Take for example the case of a#20 Awg conductor insulated with a 30 mil wall of polyethylene, the conductor preheated to 300 deg. F. and the insulation extruded at a compound temperature of 425 deg. Fahrenheit. If the wire was traveling at a speed of 1000 ft./min. and if the cooling troughs of each temperature increment were of sufficient length to bring the wire down to the temperature of that gradient, then the total length of the cooling trough would be in the vicinity of 17 miles. It is also obvious to anyone who has had experience in running high quality polyethylene extrusions that cooling these walls to the point where they are stone cold is neither necessary nor practical. All indications point to the fact that once a temperature of 167 deg, F. is reached, deformation and the formation of voids has been eliminated.

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The temperature gradient principle was established on the premise that successively cooler troughs served to rapidly bring the insulation to a lower temperature without quenching effects. While this is true, the use of short troughs, each with a lower temperature gradient, may still result in the formation of voids. It was previously mentioned that the transition temperature from a viscous liquid to a solid was approximately 221 deg. F. for polyethylene. This is the critical temperature area from the viewpoint of case hardening and excessive shrinkage versus temperature change. From this information it would appear advisable to control cool the insulation at a temperature as close as practical to 221 deg. Fahrenheit. 180 deg. F. water seems to be this practical temperature. The use of a single, long, 180 deg. F. cooling trough rather than three or more shorter ones, each at a different temperature, is preferable if the dwell time in the first trough is so short that exposure to lower temperature in succeeding troughs might cause conditions conducive to the formation of voids.

★ ★ ★

Our research and development work with heavy-walled coaxial cables has helped us appreciably in designing other cables such as power and the so-called GTO cables which have high voltage requirements. It was found that by controlled cooling of these cables, the high voltage requirement could be met; this could be accomplished by no other method.

★ ★ ★

This brings us to another important point. Controlled cooling not only serves to eliminate voids but is responsible for obtaining the proper crystalline/amorphous combination which results in optimum dielectric properties. Manufacturers have frequently been faced with the problem of bringing the extruded cable down to room temperature in a way that will allow the proper dwell at a given temperature so as to approach the crystal-amorphous condition that is normal for polyethylene and therefore achieve a desired density and dielectric strength. Sudden cooling at low temperatures from a practical point of view results in a more amorphous insulation whereas slow cooling at higher temperatures encourages crystal growth. Time is required to achieve a stable crystalline/amorphous balance. Slow, uniform cooling reduces this time element to a minimum.

★ ★ ★

The importance of proper cooling and its effect on crystallinity, density and dielectric strength is verified by cables which have been found to fail an extended voltage test immediately after manufacture, yet pass the same test after a natural aging of several months. Because of improper cooling during manufacture, the resin continues trying to achieve its normal crystalline/amorphous state on aging.

★ ★ ★

All of our considerations thus far have concerned heavy walls. The wire and cable industry is aware of the benefits of controlled cooling, the factors that make it necessary and the properties that are affected by it. There has been, however, a general tendency within the wire and cable industry to believe that there is a wall thickness below which controlled cooling is not necessary. Experience proves this belief to be incorrect.

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The thinking on the part of the wire and cable industry concerning controlled cooling for thin-walled constructions is governed by practical considerations. In the latter stages of World War II, polyethylene's use was extended to infantry wire (WD-1/TT) as additional quantities of the material became available. This construction consists of a relatively thin wall over a thin conductor. Unfortunately the insulation used was black in color and consequently any defects in the polyethylene were not visible. Because of the nature of infantry field wire (thin walls on small wires), it was possible to extrude it at extremely high speeds—for the most part above 1000 ft./min. and in many cases as high as 2000 ft./minute.

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Running at these high speeds incurred the necessity for rapidly cooling the insulation to prevent deformation when it passed over the capstan. In some instances extruders even resorted to the use of refrigerated water for cooling.

(*Please turn to page* 891)

Continuous Annealing, Preheating and Insulating of Electrical Conductors

by Brooke W. Lerch

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Western Electric Company, Inc.

Baltimore, Maryland

A paper presented at the Regional Meeting of the Electric Wire and Cable Section of The Wire Association in Boston, Mass., on April 30, 1959.

Electrical resistance heating of copper conductor was used in tandem with continuous vulcanizing lines early in World War II to heat the wire prior to its introduction into a bonding agent and then into the extruding head. When thermoplastics were introduced as insulating materials, the need for a bond between the thermoplastics and the conductor was recognized. Preheating the conductor was a partial answer. Partial because stretch of the conductor in the insulating lines and other operations, in some cases, reduced the adhesion obtained by preheating. It was also found that variables such as compound pressure and temperature, as well as the temperature of the wire during extrusion, had a marked effect on the shrinkage of the plastic insulation.

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Preheating the conductor also reduces thermoplastic cracking in cold bend tests. Again it must be conceded that by adjusting temperatures, insulating speeds and materials, non-cracking, non-shrinking insulations have been obtained without preheating conductors. Certainly vinyls are more subject to thermal cracking than are polyethylenes.

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In many operations moisture on a conductor prior to insulating will produce a line of bubbles under the insulation. This condition can be improved or eliminated by preheating the conductor to a temperature in the range of 120° to 280°F.

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The subject of strand annealing will be limited to electrical resistance annealing of solid copper wire in tandem with an extruding machine which may be supplied from a hard copper supply position or from the capstan of a wire drawing machine.

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Strand annealing consists of heating a moving conductor with an electric current to a sufficiently high temperature to anneal the copper. It may then be quenched and reheated to a temperature required in subsequent operations. This can be accomplished at wire speeds as high as 4000 feet per minute. Later in this paper limitations in wire speed will be discussed in detail.

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Before going into the technical aspects of the annealing process a general description of the tandem insulating line is in order. Forty-two of these insulating lines, as shown in Fig. 1, are in use at the Point Breeze Works of the Western Electric Company in Baltimore. They were put into operation two years ago as part of the polyethylene facilities for the manufacture of exchange area cable. Fig. 2 is a schematic of a tandem line and shows the location of the annealer in the line. Bare hard copper conductor in any one of four gauges, 19, 22, 24 and 26, starts from a 400 pound continuous flyoff position and enters the strand annealer where the wire is annealed, quenched, cleaned and dried before passing through a thermo-couple nib into the extruding head. The polyethylene coated wire is pulled through a 17 foot long water trough by wet, multiple groove capstans. Moisture is blown from the surface of the insulation by low pressure air, after which the

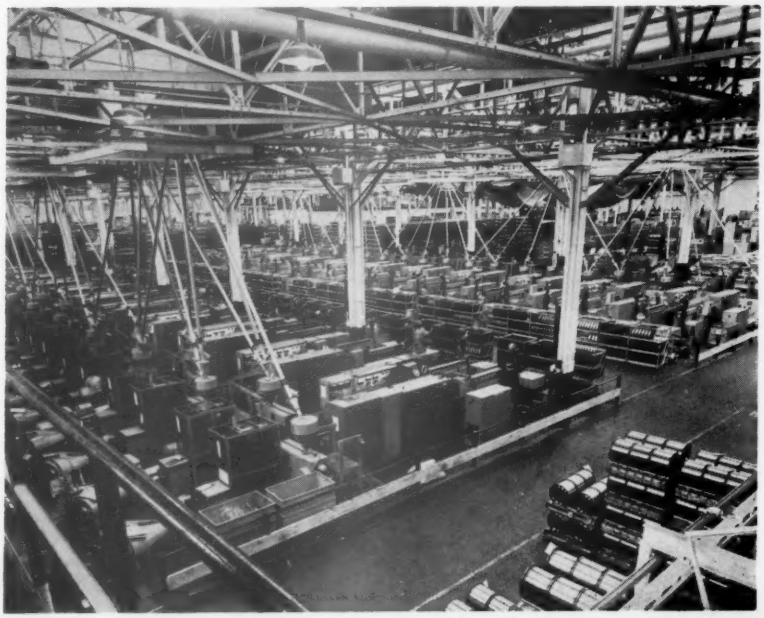

Fig. 1 * * * * * * * * * * * * * * * * * *

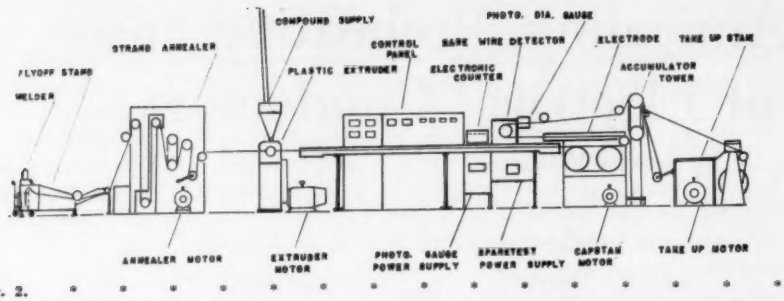

Fig. 2.

insulated conductor passes through a 3500 volt electrode, a bare wire detector and a photoelectric diameter gauge to an accumulator tower and is then wound on reels in a double automatic take-up unit.

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Each line produces over one million conductor feet per eight hour shift. The length of the line is short compared to other commercial installations but this compression of the line was necessary to save space and has been accomplished by doubling back and forth of the wire path. For this reason, some of the units, including the annealer, had to be designed and built to fit into the space allotted. The wire contacts 49 sheave wheels in a 2.6 second journey through the line.

★ ★ ★

There are four major motor drives in each line; one each for the annealer, extruder, capstan and take-up. The tension and speed problems in a tandem line may be illustrated by the following analogy in which motor cycles simulate the annealer, capstan and take-up drives.

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Three motor cycles which are tied together with an annealed 26 gauge copper wire start from rest and accelerate to 35 miles per hour, never allowing the wire tension to exceed one pound. At intervals accurate to a tenth of a second, a fourth motor cycle, simulating wire transfer from a full to empty reel, rushes to the front of the line at 60 miles per hour, grabs the wire, and in a fraction of a second, slows down to 35 miles per hour. This happens every 12 or 20 minutes, 24 hours a day, to 42 such lines. Two misses per line per day is considered par.

To illustrate the detail operation, Fig. 3 shows a schematic of the annealer. The wire enters the annealer over contact sheave #1, which is connected to terminal "A" of the transformer secondary. The wire passes through a steam filled annealer tube to contact sheave #2, which rotates in water and is connected to terminal "B" of the transformer secondary. (Note: The water level in the tank is below the annealing tube "A"). The bare conductor is water cooled in tube "C," then wiped dry with compressed air. It then passes to contact sheave #3, which in turn is connected through a variable resistance to terminal "A" of the power transformer. The tension in the wire actuates a dancer arm to control the speed of the sheaves through a potentiometer in the control circuit. The wire enters the extruding head at a temperature of approximately 130°F.

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The surface speed of all contact sheaves is maintained by the fact that they are all the same diameter and driven by timing belts from an eddy current clutch motor. The speed control arm actuating the variable resistance matches the sheave speed to wire speed, which accounts for a low rate of sheave wear. After more than two years of operation we are now ordering our first replacement sheaves although the original ones have all been regrooved several times.

★ ★ ★

The power supply is 30 KVA alternating current five tap transformer having a maximum voltage of 40 and the voltage used is dependent upon the gauge of wire processed. Note the buck or boost transformer mounted across the center variable transformer taps which provides close adjustment in the primary of the power supply and thus accurate control in the secondary circuit. Also a resistance across the center taps protects the windings if the load across the contact sheaves is suddenly disconnected.

★ ★ ★

In the annealer operation the applied voltage is increased to a point where additional voltage does not produce an increase in current flow in the conductor. This built in compensating phenomenon will anneal conductors operating in a speed range of 2000 to 3000 feet per minute.

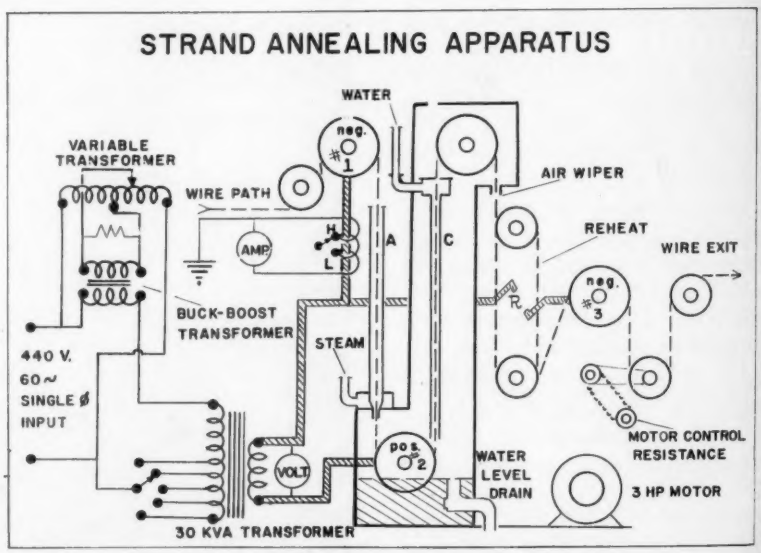
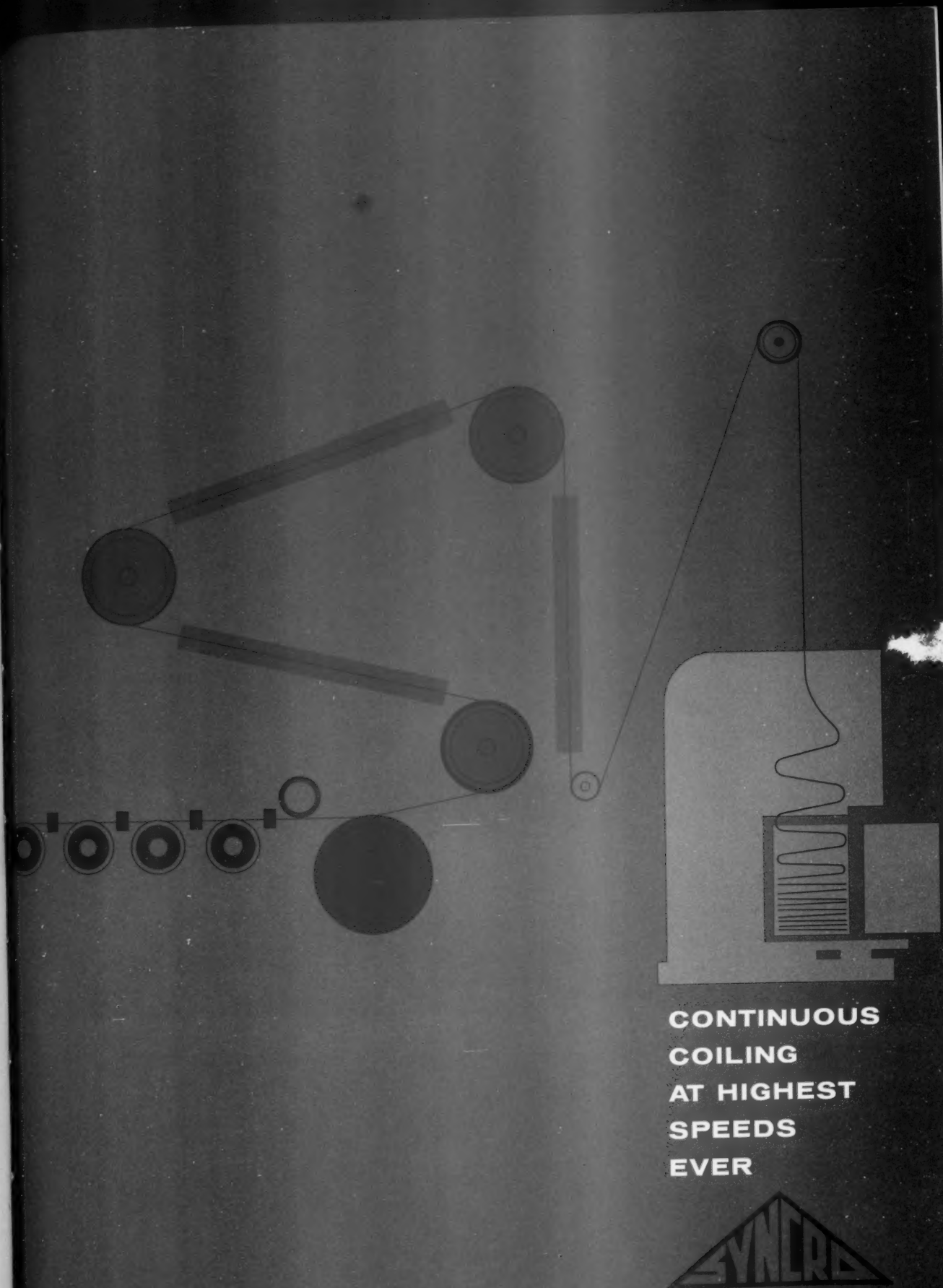


Fig. 3


CONTINUOUS
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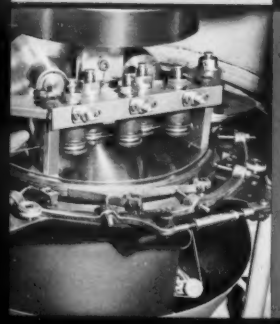
Continucoil*

SGD-1

Wire is wound around the capstan by specially arranged guides. The windings fall freely, without rotation into the stationary take-up drum directly below the capstan. An accumulator, located between the capstan and the drum, can be closed at the bottom to collect the windings once the drum is filled. An empty drum which rests on a swivel platform, is shifted into position by a foot lever. When the accumulator is opened the windings fall freely into the new drum.

The new continuous coiler is shown below as it appears fully assembled.
Cover doors, which give easy access to wire guides and the coiler capstan, are interlocked in a closed position while the machine is in operation.



Patents Applied For

Steel collecting drums, with cores to define the wire storage area, can be furnishd with the new coiler. These durable drums, ideal for in-plant use, are fitted with "feet" to ease transportation and stacked storage. Specially designed hand barrows facilitate drum handling and may be used by operators and fork-lift trucks for inter-department shuttling. The steel drum is 20 inches in diameter, has a 14 inch core, and stands 30 inches high. A slot, running from top to bottom, allows wire ends to run up and out of the drum for continuous payoff operations. Commercially available fibre drums with similar dimensions can be accommodated by the coiler for ready-packed shipping requirements.

SYNCRO

SYNCRO MACHINE COMPANY

Perth Amboy, New Jersey, USA

affiliated company: WINGET SYNCRO, LTD., Rochester, Kent, England

Better Machinery for the Wire Industry

Syncro Machine Company is now manufacturing its new Continucoil Model SGD-1. The machine combines, for the first time, continuous coiling and operating capacities geared to modern high speed wire drawing and annealing equipment. It incorporates a capstan and associated guiding mechanisms, a wire accumulator, and non-rotating collecting drums. The new continuous system eliminates previous coiling speed restrictions and production shut downs.

Lower speed units also available for Tinning, Extruding and other applications.

Continucoil operates in a range of copper wire sizes from number 8 to number 24 Brown and Sharpe gauge at the following speeds.

B&S Gauge	Max. Speed
#8 & #9	2750 FPM
#10 & #11	3500 FPM
#12 through #24	4000 FPM

* TRADEMARK APPLIED FOR

The 25 feet of reheating between contact sheaves #2 and#3 insures dry wire at 130°F. This low wire temperature has little or no bearing on shrink back or adhesion. The temperature of the reheated conductor can be varied with resistance "R," although the primary purpose of this resistance is to balance the potential in sheaves #1 and #3 to prevent current flow to grounded machine elements.

★ ★ ★

Temperature measurement of the conductor prior to its entrance into the extruding head is made with a thermocouple welded in a tungsten carbide nib, which in turn is molded into an epoxy block with a miniature two prong receptacle for electrical connection to a temperature indicating meter. The temperature indicated is relative because of the frictional heat developed between the nib and of course, in time a groove wears into one side of the hole. It is inadvisable to process a larger size conductor than the conductor that formed the groove or two sharp lines will be cut into every foot of conductor processed.

★ ★ ★

There are many advantages in using strand annealing; also there are limitations and penalties. Generally, strand annealing is a more economical operation than bulk annealing. This, of course, is dependent upon the quantity of wire to be processed, the size of the wire and other process benefits which may be obtained simultaneously with annealing, such as preheating. After operating our machines for two years we find that the process and maintenance costs are less for strand annealing than bulk annealing. We also have concluded that in the tandem insulating lines, consisting of supply, take-up, extruder and annealer, the latter requires less adjustment and maintenance than the other units

★ ★ ★

Hard drawn copper wire from a supply position is less difficult to handle than wire that has been annealed. This becomes more apparent as the size of the wire processed becomes finer. Wires annealed on spools present problems such as "sticky" windings which amplify the difficulties of tension and distribution in the spool. Fly off of wire above 1500 feet per minute is practical for hard wire even in fine gauges and is difficult for soft wire. For example, 26 gauge hard wire will fly off at 2500 to 3000 feet per minute without stretch but annealed wire may reduce in diameter .0002″ at the sticky spots in the reel.

★ ★ ★

Limited experience indicates that strand annealing is satisfactory for solid conductor but impractical for stranded conductor. The center wire, of a 7 strand construction because of variation in tightness of strand and resulting variability of contact resistance between strand members, is spotty in anneal. Commercial practice is to anneal the wire before stranding.

★ ★ ★

Usually heavy gauges of solid conductor, 16 or heavier, are not strand annealed in a tandem insulating line because of the required high current flow and resulting contact problems with the sheaves. Most of the commercial copper rod drawn into fine gauge sizes contains some non-copper inclusions. A cross section of the wire through an inclusion usually shows a ratio of little copper area to inclusion area. This is a high resistance point which invariably burns out in the annealing leg between the number 1 and number 2 contact sheaves. The annealer is a positive inspector; it does not pass inclusions into the finished product. It is preferable to have potential trouble spots in the conductor burn out in the annealer rather than in subsequent operations or in finished cable. One burn out or less per million feet of wire processed is normal and three per million is unsatisfactory, resulting in abnormally high operating costs.

★ ★ ★

Strand annealing produces a clean wire. The residual layer of copper dust and drawing compound fats found on batch annealed wire are literally exploded from the conductor surface as the hot wire enters water. This is an advantage but creates another problem because the unlubricated dry wire is an excellent saw or lap. Under these conditions a metallic core tube or guider will wear out after processing a few million feet of wire. By inserting a diamond in the tip of the tube the amount of wire processed increases to 50 million and in some cases, 500 million feet.

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The goal in strand or any annealing operation is to produce a bright wire. Heavier sizes, 19 gauge and up, are more likely to discolor than finer gauges. For satisfactory soldering, a bright or reddish copper must be produced. Purple, black or brassy wire cannot be soldered readily. When the wire is in the annealing tube it reaches greatest temperature as it approaches the number 2 contact sheave. The inert steam atmosphere must surround the conductor to prevent oxidation at this point. It is more difficult to remove the heat in the heavy wire than in lighter wire, thus the heavy wires are more subject to discoloration.

★ ★ ★

One of the greatest difficulties in any annealing operation is to obtain consistent annealing if the rod contains varying amounts of an impurity such as silver. Five ounces of silver per ton of copper requires the annealing temperature to be increased 200°F. to obtain a full anneal. Fortunately, today there is very little silver in the copper. When hard copper, due to contamination, is found by statistical quality control, immediate adjustment can be made in the strand annealing temperature. This is not possible in batch annealing where the entire annealer load must be reprocessed when low elongation conductor is found.

★ ★ ★

Wire stretch in the copper conductor insulating line increases each time that the wire is bent around a sheave and in most insulating lines there are many sheaves, rollers and guides. Copper is not elastic and each time the wire is bent, half of the wire area above the neutral axis stretches and as the wire is straightened the elongation is not absorbed. The

(*Please turn to page* 881)

Steel collecting drums, with cores to define the wire storage area, can be furnishd with the new

Quality Control In The Manufacture of Submarine Cable

by William M. Fleming, Jr.
Quality Control Superintendent
Simplex Wire & Cable Co.
Submarine Cable Division
Newington, New Hampshire

In New Hampshire, Simplex is engaged in the manufacture of long, continuous lengths of submarine cables for communication purposes. These cables are stored in tanks, submerged in water, and shipped by coiling into the tanks of a cable ship. The durability and transmission requirements of these cables impose a need for extraordinary process controls and the use of extra-high-grade materials. Specification requirements are so exacting, in fact, that materials are exceptionally costly. Samples of coaxial telephone cable types are shown in Figure 1. Figure 2 illustrates details of cable construction.

Fig. 1—Coaxial Telephone Cables—Types AA, A, B, & D. Cable constructions vary according to depth of water in which cable is to be laid and type of ocean bottom. Type AA is a shore end; type D is the deep-sea end. * * * * * * *

Manufacturing schedules are such that great quantities of material are used. It is necessary, therefore, to order large lots of material well enough in advance to meet these schedules. This practice magnifies the problems with any given material, and thereby requires the development of methods that will provide knowledge of the quality level prior to the start of manufacture. Rigid quality requirements are necessary not only because of design considerations but because the expense of repair or replacement of a cable is great. In contrast to land telephone cable that can usually be repaired for a few hundred dollars, an underwater cable repair costs many thousands of dollars; and the loss of service can be expensive, too. Just to cite one difficulty, cable repairs are made by ship and therefore can be subject to serious delays because of weather. Thus, the problems associated with the submarine cable industry require the development of good quality-control techniques.

William M. Fleming, Jr.

The author graduated from Harvard University in 1947 with a degree of B.S. in Physics. Upon graduation, he joined the Engineering Department of the Simplex Wire & Cable Co. at their Cambridge Plant, where he worked until transferring to their new Submarine Cable Division at Newington, New Hampshire in 1953. His work there has been in the field of Cable Engineering until last May, when he became the Quality Control Superintendent. This paper was presented at the Regional Meeting of the Electric Wire and Cable Section of The Wire Association on April 30, 1959, at Boston, Massachusetts.

★ ★ ★

In deciding what functions Quality Control should comprise, the cable industry appears to agree that Inspection is one of the more important. All companies provide inspection in order to be sure that the product they are making meets design requirements on a continu-

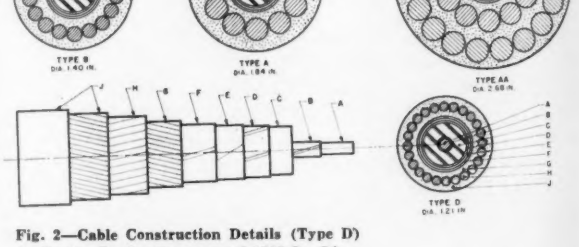

Fig. 2—Cable Construction Details (Type D)
A. Center Conductor, copper 0.1318 In. Dia.
B. 3 Surround Tapes, Copper 0.0145 In.
C. Polyethylene, to 0.620 In. Dia.
D. 6 Return Tapes. Copper 0.016 In.
E. Teredo Tape, Copper (overlapped) 0.003 In.
F. Cable Tape (Gapped)
G. 1 Serving Cutched Jute
H. 24 Armor Wires, High Tensile Steel, 0.086 In. Dia. (each wire knitted)
J. 2 Servings Impregnated Jute.
—Courtesy of Bell Telephone Laboratories, Inc.

ing basis and will consequently be acceptable to the customer. This usually takes the form of a detailed in-process inspection, and in some instances a materials check. The purpose is to separate those nonconforming items from the conforming ones. This merely amounts to a "calling out" procedure, however, and more often than not, no means are provided to prevent recurrences. Even under an arrangement whereby means are provided to correct probems as they happen, it is obvious that detection occurs after, rather than before, the fact. This permits a problem to become more complex and costly.

* * *

Once a problem develops on the production line, it becomes magnified because of the many aspects of the manufacturing process involved. Production schedules, inventory, and particularly the cost due to the additional labor and materials that have been expended are all affected. In order to avoid these complications and isolate a problem at any given stage, emphasis must be on preventive, rather than corrective, measures. In other words, "the radar must be on the bow and not on the stern". With acceptance of such a philosophy, Quality Control takes on a broader scope, starting with the supply of materials from the vendor and carrying through to the final acceptance of the cable by the customer.

* * *

With a scope this broad, the objectives of Quality Control should be well defined, and they must be integrated with others of the company to be effective. In defining quality-control objectives, direction can be obtained by examining the cost picture. In the submarine cable industry, materials comprise the greatest of the three major elements of factory-door cost. They constitute approximately 70 per cent of this cost; labor and factory overhead make up the remaining 30 per cent. Thus, material is of prime importance in the cost of submarine cable, and methods must necessarily be designed to control material costs.

* * *

In order to determine the effectiveness of the efforts of the quality control organization in carrying out its objectives, we must be able to measure its performance. Simplex uses a "standard cost" system, which measures performance with respect to a standard. Any deviation therefrom is reported as a variance. This permits discrepancies to be called out on a historical data basis, that they may be analyzed and corrective action taken. This alone is not enough. Quality Control must of its own accord set up means by which the quality of a material is appraised on a day-by-day basis. In this way, problems may be segregated for evaluation into their proper categories, such as production, use, storage, or those intrinsic to the material.

* * *

All departments of the organization are responsible for quality. The Engineering Group must consider the effect of the design requirements on cost. The Manufacturing Group is responsible for making the product in accordance with standards; they thereby ultimately control its quality. As the enforcing agency, Quality Control is in the best position to provide stimulus for the achievement of objectives, and their success depends on good communications with other departments.

* * *

It is Quality Control's responsibility to provide Purchasing with information on the problems encountered in purchased materials and assist them in maintaining satisfactory quality standards by the vendors. Quality Control should provide vendors with the specification requirements and define the intent of what we are trying to accomplish. The responsibilty of the supplier should be clearly spelled out and any special inspection arranged for. It is also Quality Control's responsibility to acquaint the suppliers with problems arising with the use of their materials on a current basis and thereby improve the quality level. Plant visits have been very helpful to the supplier in understanding the problem.

* * *

The Production Control Department must be advised of the release of materials after inspection and of any anticipated problems that may affect the inventory. This must be done at the time of receiving, as well as on a day-by-day basis, in order to evaluate properly the effect of rejections on inventory.

* * *

The Cost Department must be advised of any decisions affecting costs, such as will result when materials are rejected.

* * *

The Engineering Group must be informed of problems that persist, that they may investigate materials or methods of manufacture. Their approval must be obtained for deviations from the specification requirements where overall quality is judged not to be jeopardized.

* * *

Finally, communications must be maintained with the Manufacturing Departments relative to their effectiveness in achieving the quality level desired and to assist them, where possible, in areas requiring action. Specification interpretation is an important part of the communications, and Quality Control acts as liaison with Engineering in this respect. A "Standard Practices and Instruction Manual" is maintained to provide supervisory personnel with procedures that satisfy specification requirements. These procedures are approved by the Engineering, Control and Manufacturing Departments. Quality Deviation Reports are issued whenever non-conformances develop. This report is given to the Supervisor of the department in which the deviation occurs, whose responsibility it is to investigate and report the corrective action in writing.

* * *

The Quality Control Department at Simplex is made up of five separate sections. Each section is independent of the other and is responsible for its own job as it is related to materials, in-process, and final inspections.

* * *

The following is a description of the functions of each section:

Materials Inspection is responsible

for providing adequate inspection of purchased materials to assure that only approved material is used in the manufacturing processes. In order to accomplish this, materials are inspected either at the supplier's plant or on receipt at Simplex. The decision on where to inspect materials is dependent on how critical the material is and on current problems. Because of the limitations of end sampling, final acceptance of all material must be contingent on its successful processing.

This group is also responsible for evaluating material problems and reaching a decision in regard to the problems and recommending action to be taken. Communications with Purchasing and the vendor are the responsibility of Materials Inspection. It is vital for Materials Inspection to keep the problems of materials separate from production problems in order that these problems may have the least effect on objectives. This is particularly important in the submarine-cable industry because the risk of generating large quantities of non-conforming material is high.

Process Inspection is responsible for providing adequate in-process inspection in order to determine that the product conforms to all requirements before it is sent along for further processing. It is vital that problems be found as early in the operation as possible in order to minimize the generation of non-conforming cable and to avoid the compounding of problems by passing them from one operation to another. It is their duty to issue Quality Deviation Reports.

Final acceptance of the cable is made by Process Inspection only after determining that all requirements have been met. When approval by a customer's inspector is required, it is their duty to obtain his approval.

Production joints must be of good, consistent quality. In order to control the quality of these joints, a program has been established that requires periodic qualification of both machine and operator. Samples are submitted on an initial and continuing basis, and they are tested for evidence of proficiency. Operators are not allowed to make joints until the test results are known. As further evidence that joints put into the cable are of the same quality as those used for qualification, joints intended for production are sampled and tested. This practice is known as a Process Audit. It is the duty of Process Inspection to administer the Qualification and Audit programs as well as assure the accuracy of all equipment used to measure and gauge the product.

Quality Analysis is responsible for analyzing data and developing suitable control charts. They assist other departments in the organization by analyzing charts and evaluating problems by the use of statistical analysis methods.

The insulating operation is controlled by automatic equipment such as diameter gauges, concentricity gauges, and capacitance monitors. It is the duty of this group to determine the quality level of insulated conductor by an analysis of all control charts, process logs, and physical-test data. It is imperative to investigate every irregularity, that the problem may be evaluated in order to correct it in the future. Communications must be maintained with the appropriate manufacturing section relative to the problems encountered.

Control Laboratory is responsible for conducting physical and chemical tests on all incoming and in-process material. It is their duty to be alert to unusual conditions that might show up in the performance of the tests and to report them to the appropriate section. When required, they conduct special tests to evaluate problems.

Electrical Testing is responsible for conducting various electrical tests on cables and components in process as well as final electrical tests on completed cables.

In order to minimize the generation of non-conforming material, electrical tests are conducted on in-process cable as soon as possible. In the event of a processing change that may affect electrical characteristics, electrical tests are conducted out of normal manufacturing sequence in order to evaluate possible effects of the change.

In addition to the five independent Sections, there is a Quality General Supervisor responsible for maintaining a program of indoctrinating new employees with, and reminding old ones of, management's philosophy relative to quality standards. His responsibility also is to promote quality throughout the organization and to coordinate the successful resolution of unusual problems that do not normally fall within the scope of any of the five sections.

★ ★ ★

Integration of the quality effort is accomplished by establishing methods that separate problems and return them to that function having the initial responsibility so they can best be handled. For instance, all non-conforming materials, wherever they are detected, become the property of Quality Control. It is their responsibility to get proper disposition, and assurance that corrective action has been taken. In the event problems develop with purchased material during processing, Process Inspection will reject the material and return it to the rejected-material area in the warehouse where Materials Inspection will examine the material and reach a suitable decision.

★ ★ ★

The solutions may vary but typical examples are as follows:

1. Return to vendor for credit
2. Run at reduced speed
3. Sell at highest scrap price

Fig. 3—Armor Line at Simplex's Submarine Cable Division; Newington, New Hampshire. Note cable core coming down from overhead on left into the machine.

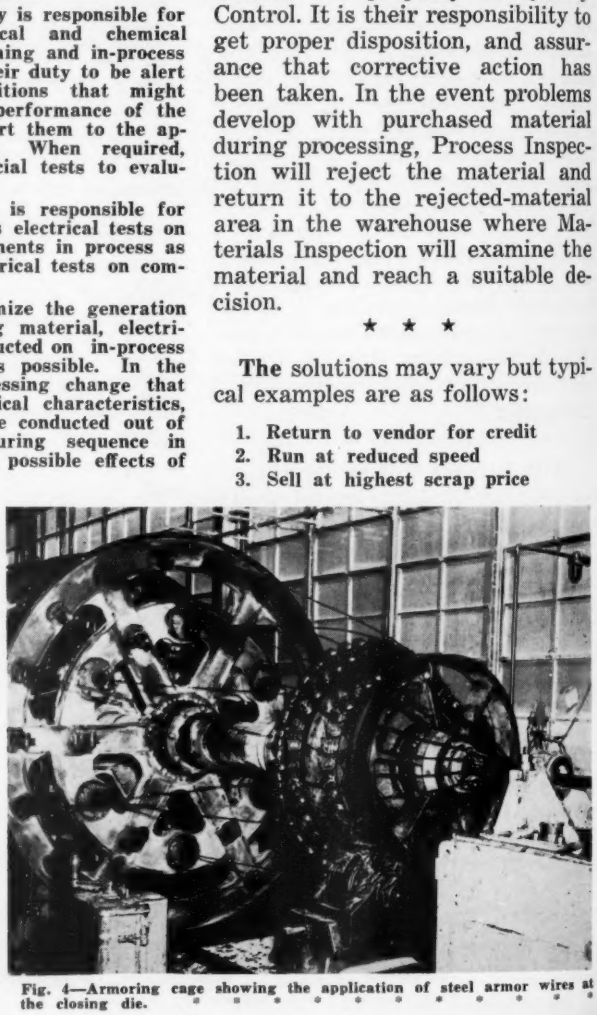

Fig. 4—Armoring cage showing the application of steel armor wires at the closing die.

This provides the means by which decisions and follow-up may be made without the pressures of production.

★ ★ ★

Until now this paper has been concerned with defining the concept of Quality Control at Simplex and describing the relationships and responsibilities of the Quality Control Department. Let's now have a look at a few examples of how quality control has been put to work.

Example 1:

The armoring of submarine cables is done on an armor line that consists of several pieces of equipment all driven from a common line shaft as shown in Figures 3 and 4. Each component of equipment performs an operation that successively builds up the cable as it runs through the line. This operation is similar to that of any armoring operation and normally is concerned with the application of tapes, armor bedding, armor wires, and outer serves. Because the lengths being manufactured are long and continuous, the materials being applied run out before completion of the length. It does not make sense, therefore, to have these components running out at different times. If the run-out of materials can be controlled, the line can be made to operate much more efficiently and greater production will result. At Simplex, the method by which the armor lines are controlled is known as "cycling." The cycle comprises two phases: 1) the loading of materials into the line at scheduled intervals and 2) the continuous operation of the line until the next loading phase. For a given cable, the line runs a predetermined footage before shutting down to replenish the supply of material. If the machine makes any unscheduled stop during the "run phase," the cause is determined and corrective action taken immediately. For "cycling" to be effective, the size of the material packages must be controlled within set limits. This has led to the adoption of new concepts in the purchase of materials. The materials for these lines, are, except in a few cases, purchased by the foot rather than by the pound. Even in the case where material is still being purchased by the pound, it is on a measurement basis and with limits established.

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Performance of the armor line is therefore measured against standards that have been set by expectation from "cycling." Conditions arising that interfere with the "cycling" affect the performance and must be corrected. The problems are varied but in large measure are inherent in the purchased materials. This has required the correction of these problems at the supplier in order to prevent them in the future. As described earlier, such rejected material becomes the property of the Quality Control Department; here it is analyzed and a successful solution obtained. The correction of material problems together with the success of both Manufacturing and Engineering in solving other problems has led to the following increase in production, which more than offsets the extra cost of measured material:

> **Average daily production covering a long period of time before "cycling" was 3.78 nautical miles per day. "Cycling" almost immediately reduced "down time" by approximately 30 per cent. This resulted in an increase in production to 5.0 nautical miles per day.**

Example 2:

In order to protect the inventory, minimize the possibility of nonconforming materials interfering with production, and evaluate quality level, each shipment of critical material is sampled and run on the line out of the normal FIFO system. While this is not 100 per cent assurance, it does provide an additional means for discovering problems early. Problems so discovered can then be evaluated by whatever means are required prior to actually running the material on the production line. In some cases, it is necessary to run the material in order to define the extent of the difficulty; but with advance knowledge of conditions that may possibly exist, procedures can be established that create the least interference with production.

★ ★ ★

The feedback of information on the conditions discovered has the advantage of not only appraising the quality level, but the additional advantage of determining the problems current with a particular suppler's material. Problems can be such that they should be called to his attention immediately because of the possible effect on material then in production. We have had instances where problems reported by phone resulted in machine changes by the supplier and additional inspection for the material already produced.

★ ★ ★

This practice of evaluating and correcting material problems has not only led to increased production but has reduced scrap cost resulting from non-conforming material.

Example 3:

The importance of dealing with the problems of Examples 1 and 2 can perhaps be better understood by considering the following one: This concerns a scratch on a copper tape at the armor process which was caused by a small piece of foreign material in the die. The scratch continued for a distance of several hundred feet before it was discovered; and although this represents a manufacturing problem, there have been other similar occurrences that were material problems.

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In order to effect the repair, the armor line had to be backed up and the damaged material replaced. This repair required a total of 335 man-hours. The cost in labor, overhead, and material was approximately $3,000.00. This does not take into account the profit the machine could have earned had production continued uninterrupted. The total cost of the bobbin of material that was damaged was only $175.00. A comparison of these costs indicates the necessity for preventing non-conforming material from getting into the product and for detecting any non-conformance as soon as possible

Example 4:

This example concerns the insu-

(*Please turn to page* 893)

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JULY 1959

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Regional Meeting of The Electric Wire and Cable Section

by Edmund D. Sickels, Editor
Wire and Wire Products
Stamford, Connecticut

This Regional Meeting, held on April 29 and 30 at the Statler-Hilton Hotel in Boston, Massachusetts, was the first one to be devoted exclusively to the interests of electric wire and cable production men under the auspices of the Electric Wire and Cable Committee of **The Wire Association.**

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That it was outstandingly successful from an attendance standpoint was evidenced by the fact that 340 persons attended and registered. That it was highly satisfactory in other ways was attested to by the many, many favorable comments heard on every hand during and after the meeting.

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The registration desk opened at 9:00 A.M. on Wednesday, April 29. At 10:00 A.M. the Electric Wire and Cable Committee held a meeting to discuss future plans. At the same time, the ladies who had come with their menfolk gathered in another room for a "get-acquainted" coffee hour and to learn of the plans set up by the Program Committee for their entertainment in the afternoon. **Joseph P. Wildgoose,** Development Engineer, **Collyer Wire & Cable Company,** who was in charge of this event, explained the tour to historic points of interest in Boston that had been arranged for them and saw them off at 1:00 P.M. Later word received indicated that the tour had been interesting and very worth while.

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At 12:15 P.M. a luncheon was held by the Program Committee for the program participants, following which **Clement C. Lawson,** Chairman of the Electric Wire and Cable Committee expressed his appreciation to those present for the fine work apparent in preparing for the meeting, to which **Allan B. Dove,** Association President, added his voice of approval, thanks and welcome.

Urbain J. H. Malo
Chairman of Program Committee

The Technical Sessions

At 1:45 P.M. on Wednesday, with more than 200 men gathered for the first session, **Mr. Malo** opened the session and introduced Association President, **Allan B. Dove,** who briefly welcomed the group to the meeting.

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The moderator for this session was **James E. Flood,** Technical Director of **Plastic Wire and Cable Corporation,** Jewett City, Conn. He called upon **George E. Carle,** Division Engineer—Extruding, **Farrel-Birmingham Co.,** Ansonia, Conn., who delivered a paper "Induction Heating System for Thermoplastic Extrusion", of which **Peter Hold,** Research and Development Engineer, had been co-author. The paper evinced considerable interest as the heating system described added something new to the concepts of extrusion.

★ ★ ★

Philip C. Greene, Sales Manager of **Davis Standard Division** of **Franklin Research Corp.,** Mystic, Conn., followed with a paper on "Insulated Wire Handling Systems", which covered both large and small diameter insulated wires, with particular emphasis on the latter.

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"Common Extrusion Problems and Their Solution" was then presented by **John L. Young,** Technical Service, Plastics Division of **Monsanto Chemical Company,** Springfield, Mass. This was a practical paper of what to do and not to do to overcome the many pitfalls encountered in extruding plastics into wire.

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The afternoon session wound up with a paper by **Arthur C. Rowley,** Sales Representative for **R. T. Vanderbilt Co.,** New York, N. Y., who spoke on the "Processing of Cross-Linked Polyethylene."

★ ★ ★

Technical Sessions were continued on Thursday morning at 9:00 o'clock with **Thomas K. Cox,** Engineer—Rubber and Plastic Covered Wire, **Western Electric Company,** Baltimore, Md., as moderator.

★ ★ ★

He called upon **Michael M. Suba,** Manager — Extrusion Materials, **Union Carbide Plastics Co.,** New York, N. Y., to deliver his paper on "Controlled Cooling of Extruded Polyethylene Insulations." In this Mr. Suba called attention to the great lengths of troughs required for perfect cooling and pointed out the practical compromises that have to be made to secure satisfactory results.

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The next paper was presented by **Brook W. Lerch,** Engineer—Rub-

ber and Plastic Insulating, **Western Electric Company,** Baltimore, Md., who spoke on "Continuous Annealing, Preheating, and Insulating of Electrical Conductors." The need for preheating, the manner of coordinating controls, the matter of current requirement and other factors that are required to make this automated line successful were described.

★ ★ ★

William M. Feming, Jr., Quality Control Superintendent, Submarine Cable Division, **Simplex Wire and Cable Company,** Newington, N. H., then spoke on "Quality Control in Processing Submarine Cable," a subject that revealed the extraordinary control measures that are required for these types of cables, in which an exceptionally large proportion of the engineering staff is engaged in quality control work.

★ ★ ★

The session was brought to a close with the showing of an excellent color movie on "Electric Wire Quality Control" provided by the **Surprenant Manufacturing Company** of Clinton, Mass. As the sound effects failed to function, **William M. Land,** Chief Chemical Engineer of the company, provided a running comment with good effect and answered questions at its end.

★ ★ ★

All papers were well-received and occasioned a lively discussion period following the delivery of each. The papers are published elsewhere in this issue.

The Hospitality Hour and Dinner

While the technical sessions may well be considered the meat of a meeting of this kind, the opportunities provided by this part of the program to meet fellow industry men is important.

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Probably at no time has one of our meetings enjoyed so eye-pleasing an atmosphere as at this Hospitality Hour, which opened at 5:45 on Wednesday afternoon, April 29. The Program Committee, in particular **Roger T. Stafford,** Project Engineer of **Kennicott Wire & Cable Company,** had arranged for a large central table, beautifully decorated and furnished with a bountiful supply of hors d'oeuvres, which was conducive to friendly conviviality. Two conveniently located bars made liquid refreshment readily available. A background of music enhanced the atmosphere. The arrangements were provided, under Mr. Stafford's direction, through the generosity of the following concerns:

Judge William E. Powers
Guest Dinner Speaker

Apex Alkali Products Co.
Apex Tire & Rubber Co.
Arlin Manufacturing Co.
The Blane Corporation
The Bridge Manufacturing Co.
Burgess Pigment Company
Central Tool & Machine Co.
Godfrey L. Cabot, Inc.
Chase & Sons, Inc.
Cook Manufacturing Co.
Coulter & McKenzie Machine Co.
Davis Electric Co.
Davis-Standard
Division of Franklin Research Corp.
Duncan M. Gillies Co., Inc.
E. I. duPont deNemours & Co.
Escambia Chemical Corp.
The Firestone Tire & Rubber Co.
Farrel-Birmingham Co.
B. F. Goodrich Chemical Co.
General Electric Co.
Chemical and Metallurgical Div.
Insulating Material Section
Haskell-Dawes Machine Co.
Irvington Div., Minnesota
Mining & Manufacturing Co.
Industrial Gauges Corp.
The Ironsides Co.
Kenrich Corp.
Ludlow Papers, Inc.
Monsanto Chemical Co.
William McCaskie, Inc.
John A. Manning Paper Co.
Masonware Co.
Mossberg Pressed Steel Corp., Div. of Wanskuck Co.
Naugatuck Chemical, Div. of U. S. Rubber Co.
New England Butt Co., Div. of Wanskuck Co.
North Anson Reel Co.
Owens-Corning Fiberglass Corp.
Prodex Corp.
Raybestos-Manhattan Co.
John Royle & Sons
Solar Compounds Corp.
Southern Clays, Inc.
Standard-Toch Chemicals, Inc.
Schenectady Varnish Co.
Syncro Machine Co.
The Torrington Manufacturing Co.
Terkelsen Machine Co.
E. W. Twitchell, Inc.
Union Carbide Plastics Co., Div. of Union Carbide Corp.
U. S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp.
The Vaughn Machinery Co.
R. T. Vanderbilt Co.
The Waterbury Farrel Foundry and Machine Co., Div. of Textron, Inc.
Wilson Products, Inc.
Wire Insulating Machinery, Inc.
Wire Machinery Corp. of America
Wire & Textile Machinery, Inc.

★ ★ ★

At 6:45 P.M. the lights were extinguished as a signal that it was time to repair to the Georgian Room for the banquet. This too was a masterpiece of tasteful decoration and arrangement.

★ ★ ★

After the dinner, Mr. Lawson introduced the people at the head table and the various members of the Program Committee seated about the room. Then he called upon President Dove, who addressed and welcomed the group to Boston. Chairman **Urbain J. H. Malo,** Technical Director of Narragansett Wire Company, then rose to introduce the speaker of the evening, **Judge William E. Powers,** Justice of the Rhode Island Supreme Court, known popularly as the "Blind Judge." His subject, "The Community's Stake in the Blind", gave opportunity for a most remarkable and inspiring talk, very largely based upon his own experiences, but so interspersed with wit and humor that his listeners frequently burst into spontaneous gales of laughter. The talk proved to be instructive, interesting, and entertaining, ending with a plea to give the blind opportunities to perform the many jobs that they are able to work at in industry. The gathering was grateful to Judge Powers for taking the time out of a busy day to come to Boston to address them. He recently appeared on a national TV program, "This is your

(*Please turn to page* 886)

The Wire Association Awards for 1958

The regular semi-annual meeting of **The Wire Association's** Board of Directors was held on Tuesday, April 28th, at the Biltmore Hotel, New York, N. Y.

* * *

With President **Allan B. Dove** presiding, the meeting was called to order at 9:30 A.M., a quorum being present. He called upon Executive Secretary **Richard E. Brown** to read the minutes of the last meeting and the Secretary Treasurer's report for the period from October 1, 1958, to March 31, 1959. Both reports were approved as presented.

* * *

In the absence of Mr. McShane, Mr. Brown read a letter from him reporting on the status of the program for the Annual Convention, indicating that both the ferrous and non-ferrous programs were practically complete, that **Dr. Jason J. Nassau,** Professor of Astronomy, Case Institute of Technology, had been selected as the after-dinner speaker, and that American Steel & Wire's Cuyahoga Works had been chosen for the ferrous plant inspection tour.

* * *

Upon recommendation of the Executive Committee the Board voted to change the procedures at the Annual Convention as follows:

Donald K. White
Ferrous Award Winner

1. **The Mordica lecture is to be presented at the joint meeting on Monday and the 25 year certificates will be presented at this time.**
2. **Discontinuance of the Annual Luncheon and also the Smoker Dinner, substituting a dinner with ladies present and with a speaker of national reputation. The fee for the dinner will be included in the registration fee.**

At the dinner the Mordica Lecture Certificate and the Medal Awards and Honorable Mentions will be presented.

Ladies Programs at Meetings

There was considerable discussion of an entertainment program for ladies, a motion being made to make such a program at the Annual Convention a part of the responsibilities of the general program chairman, such programs to be on a self-supporting basis, with the wife of the President to be an ex-officio member of the committee.

* * *

Ladies' entertainment is authorized as an Association activity only for the annual convention. Such entertainment arranged by a program committee for a regional meeting is not considered an authorized Association activity and arrangements for its financing must be made by the local committee in charge of any particular regional meeting.

* * *

D. M. Schmid, Non-Ferrous Program Chairman for the 1959 Convention, was called upon to describe the development of his program. He advised that the program would be broken into two parts—bare wire and insulated wire—for which he had a dozen papers for each lined up.

Medal Awards for 1958

Next Mr. Schmid, as Chairman of the Awards Committee, reported that they had selected **Donald K. White, of John A. Roebling's Sons Corporation,** for the Ferrous Medal Award and **Harold W. Adams, Reynolds Metals Company,** for the Non-Ferrous Medal Award.

* * *

For certificates of Honorable Mention, in the two divisions respectively, the Committee selected **Dr. Hans Krautmacher of Westfalische Union A. G. and J. F. Stoltz of Western Electric Company** as recipients. The selections were approved and Mr. Schmid thanked for his good work in this connection over the past five years.

* * *

Mr. Dove advised that he had appointed as members of the Nominating Committee for Directors **John H. Corson** (Chairman), **Harold W. Adams, Glenn R. Lee, John C. Murray, Jr.,** and **William Mohr.**

* * *

For the Nominating Committee for Officers, he named **A. M. Reeder** (Chairman), **John L. Sanderson, David M. Schmid, Benoit J. Sirois,** and **W. Roy Mackay.**

* * *

For the Executive Committee he presented the names: **Earl R. Potter** (Chairman), **Walter B. McShane, Richard E. Brown,** and **Marshall V. Yokelson.** The nominations for all committees were approved.

* * *

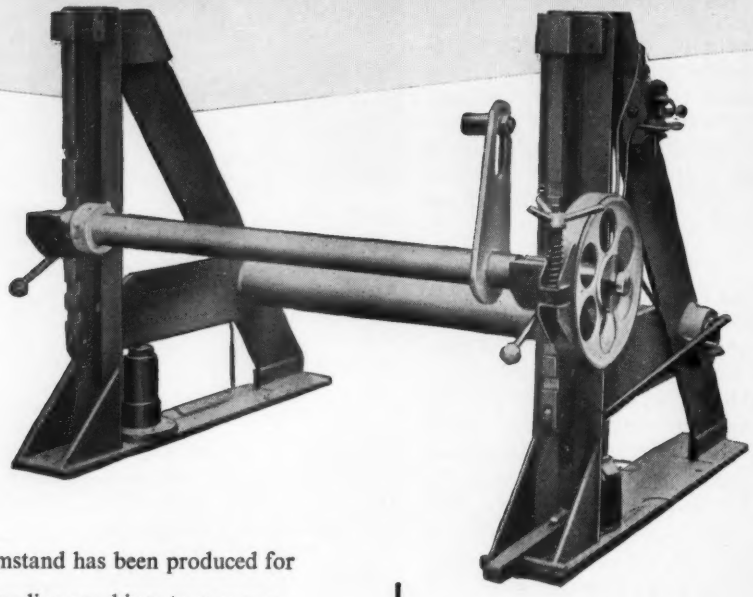
Mr. Dove then brought up the matter of the location for the 1961 convention, and suggested the se-

(*Please turn to page* 888)

Harold W. Adams
Non-Ferrous Award Winner

THE *NEW*

HYDRAULIC PAY-OUT DRUMSTAND



The new LB Hydraulic Pay-Out Drumstand has been produced for quick adaptation for use with any stranding machines to carry an additional stranded core or lead-in wire. It is ideal for extruding lines. All loading operations have been simplified. The support bearings carrying the through shaft are easily positioned ready for lifting the drum clear of the floor. Hydraulic jacks do the lifting and lowering. The tensioning device is independent of the through shaft to avoid constant dismantling. The Drumstand is made in five standard sizes to meet a variety of drum diameters up to 10 feet and weights to 10 tons. To increase the diversity of application each stand is supplied with two shafts of differing diameters.

designers and manufacturers of machines for electric cable wire rope and soft rope production

LARMUTH & BULMER LIMITED

In association with Mono Pumps Ltd. J. & E. Arnfield Ltd. Menrow Ltd. Carlisle Electrical Co. Ltd.

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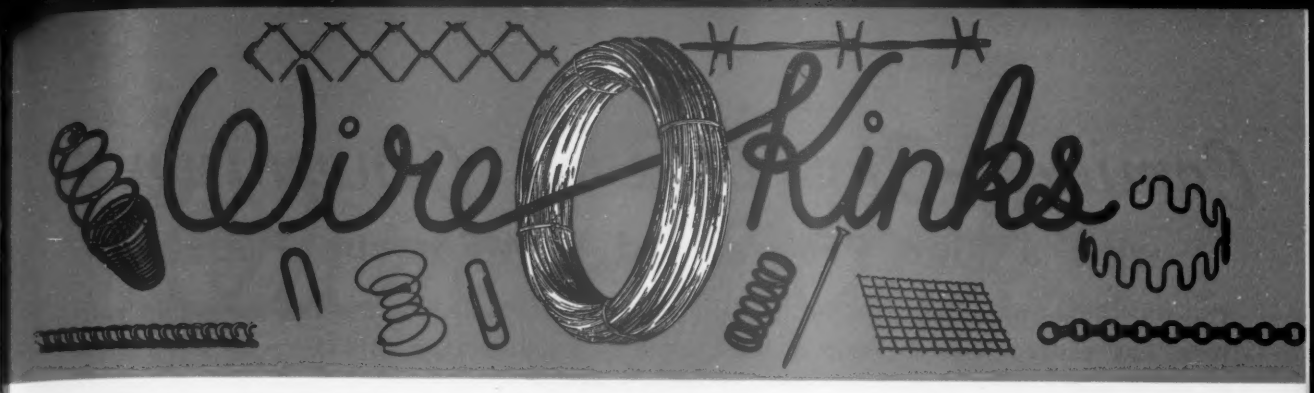
Agents in South Africa: Mono Pumps (Africa) (Pty) Limited, Audenshaw House, Wendall Street, Lakeview, Johannesburg. Telephone: 33-1112/3
Agents in Australia: Mono Pumps Limited, Mono House, 132 Burwood Road, Burwood, E.13, Melbourne, Victoria. Telephone: BW. 0291
Agents in Canada: The E.V. Larson Company Limited, 572 Queen Street, East, Toronto 2, Ontario. Telephone: Empire 4-2111

LB.8



Flexible Cable for Hard-to-Reach Induction Heating Areas

A flexible coaxial cable now permits the application of high frequency induction heating techniques in previously inaccessible areas. The cable, which is attached to an induction heater at one end and to a work coil at the other, is available in lengths from two to 20 feet.

★ ★ ★

Among the applications for the cable are: spot brazing of honeycomb structures; brazing of fluid lines in missiles and aircraft; spot annealing of titanium; local forming; heating during machining operations; and soft soldering, hardening, shrink fitting, zone refining, scanning, heat treating, and so forth.

—Courtesy of L. C. Miller Co., 5005 E. Slauson Ave., Los Angeles 22, Calif.

Quality Wire Solves Spring Problem

Production of bed springs poses difficult mechanical problems, even though mass-production methods are used.

★ ★ ★

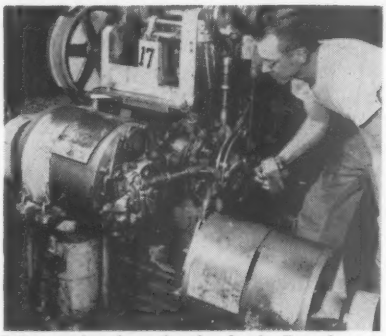
One of these problems, according to **Michael Chapis,** assistant general manager of **Posture Products Company,** Massillon, O., is the fact that springwire of consistently uniform quality is necessary for the proper operation of the coiling machines in forming springs for Sealy Posturepedic mattresses.

★ ★ ★

Posture Products uses 13½-gage **Jones & Laughlin Steel Corporation** "Mastercraft" spring wire, which it runs through a battery of Wunderlich Spring Machinery Company coilers, each of which can turn out 57 coils a minute. The

Do you have how-to-do-it items for this department? To make it a success we are depending on readers to send us material drawn from their own experience and observation. Your cooperation will be appreciated by us and our many readers.

speed and complexity of the operations makes it imperative that the quality of the wire be exceedingly uniform.



Coil emerging from forming head. Transfer arm takes raw coil to the knotter and offsetter. Coil is then electrically stress relieved. ★ ★ ★ ★

As the wire comes out of the coilers, a forming head forces it into five convolutions, making what is known in the trade as the "raw coil." The coil is grasped by a revolving transfer arm which then takes it to a part of the machine which knots the end of the coil.

★ ★ ★

The end of the convoluted wire as it comes out of the forming head must stop at a very precise point so that when the transfer arm takes it to the knotter, it will be in the exact position for this operation. Any variations, in the quality of the wire can cause trouble because it will not coil properly.

★ ★ ★

Some idea of the magnitude of the importance of wire quality is indicated by the amount of wire used in a standard full-size mattress spring. Over 1900 feet of various types of spring wire are used in a single 308-coil Posturepedic spring mattress.

★ ★ ★

The coils, of course, use the most wire. Each of the double cone coils requires 46 inches of springwire, or a total of 1181 feet. The helicals —the wires used to join the coils together—require some 580 feet of wire. Additional wire is used for lacing and for borders and braces.

Welding Electrical Connections

A low-cost method of welding electrical connections to copper and steel, called the "Thermoweld" process, has been developed.

★ ★ ★

Applicable to splice, tap, and grounding connections with cable from #4 through 2,000 mcm. and to lugs, bus and flat surfaces, the process forms a solid copper fusion weld of higher conductivity than the cable itself and impervious to moisture or corrosion.

★ ★ ★

Connections can be welded to metals including brass, bronze, copper, copperweld, everdure, galvanized steel, monel, nichrome steel, steel rail and structural steel. Welds are made with a lightweight completely portable mold requiring no external power source.

—Courtesy of the Burndy Corp., Norwalk, Conn.

How to Make Your Business More Efficient

Many business men consider themselves exceptionally efficient because they "utilize every minute", as they say. But, do they? We know very few businesses that are truly 100 per cent efficient in the following sense. Across the street are three huge buildings which cost millions of dollars. Office hours are from 9 am to 5 pm.

Coming—The Annual Convention—

with a Fine Program of Non-Ferrous Papers.

Dave Schmid, genial president of Techalloy Company, your Non-Ferrous Program Chairman, has secured with the help of his committee the following papers—with a few more to come later:

ON INSULATED WIRE

Production & Laboratory Control on High Quality P.V.C. Compounds for Wire & Cable Insulations & Jackets—by Q. R. Ball, Northern Electric Co., Montreal

Chemically Cross-Linking Polyethylene—by A. J. Snyder, Union Carbide Plastics Co.

Thin Metal Strips for Sheathing Telephone Communication Cables—by H. N. Padowicz, Senior Staff Engineer, Cable Development, Western Electric Co., Kearny Works, N. J.

Small Diameter Power & Control Cables—by Maurice Gilbert, Senior Electrical Engineer, Dupont Co.

Bonding Characteristics of Insulating Varnishes & Wire Enameling Systems—by Donald L. McClenahan, Schenectady Varnish Works.

Gang Construction Plastic Insulated Wire 3 Different Colors Extruded Simultaneously—Packard Electric, Div. of General Motors Corp., Warren, Ohio.

Boron and Phosphor Polymers for High Temperature Insulation.

Oven Aging of Polyvinyl Chloride—by S. Greene, Apex Tire and Rubber Co., Pawtucket, R. I.

New Developments in Catalytic Combustion for Fume Elimination in Wire Enameling—by R. J. Ruff, Catalytic Combustion Corp., Detroit.

Recovery of Copper and Lead from Super Insulated Wire—Electric Wire Co., Northampton, Mass.

Refrigerated Cooling for Plastic Insulated Wire—Acme Industries, Inc., Jackson, Mich.

ON BARE WIRE

Copper's Future—by R. P. Koenig, President, Cerro de Pasco Corp., New York.

New Developments in the Manufacture of Copper Wire—by Richard T. Christine, Technical Supervisor, Torrington Division, American Brass Co.

Recent Developments in Aluminum Alloy Wire—by Carl L. Kessler, Chief Metallurgist, Aluminum Co. of America, Massena, N. Y.

Titanium Zirconium Wire Drawing—by Johnston and Funk, Wooster, Ohio.

Panel Session Dealing with General Presentation of the Super Alloys and their High Temperature Properties in Wire Form.

Some Metallurgical Factors in the Production of Fine Wire, Battelle Memorial Institute, Columbus, Ohio—C. M. Jackson, J. G. Dunleavy and A. M. Hall.

New Type of Wire Weaving Loom—Warner-Swasey Co., Cleveland, Ohio.

Rhenium Wire Drawing—Bruce Gonser, Battelle Memorial Institute.

New Testing Concepts. Strain in Wires in the Elastic and Plastic Ranges by the Color Technique. Budd-Tatnall Measuring Systems. Dr. Zandman.

Glass Sealing Wires—E. G. Slick, Division Metallurgist, Sylvania Electric Products, Inc., Warren, Pa.

What's New in Copper Alloy Wire Products—Engineer from Chase Brass and Copper Co.

This preview of the Non-Ferrous Program, which will be held at the Statler Hilton Hotel, Cleveland, Ohio, October 12-15, 1959, is an indication of the types of subjects to be covered. Further details will be presented as information is received.

All papers relating to Electric Wire and Cable are prepared for the production man in the mill to provide information of practical value.

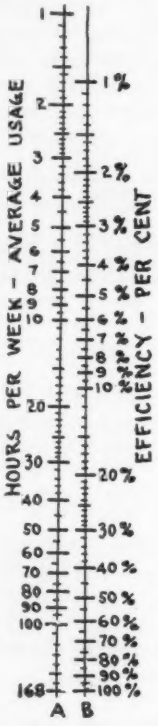
THE WIRE ASSOCIATION

RICHARD E. BROWN, *Executive Secretary*

453 MAIN STREET • **STAMFORD, CONN.**

Wire Kinks

No work on Saturdays, Sundays, or holidays. A half hour for lunch. That means 7½ hours are utilized per day, or, 37½ hours per week. There are 168 hours in each week. Therefore, during 130½ hours each week these expensive buildings are idle. The efficiency of the buildings is 37½ divided by 168, or, 0.223, which means that the efficiency is only 22.3 per cent. Not very efficient, is it?



Now, what is the efficiency of YOUR business? The accompanying chart will figure it for you in a jiffy. Find the number of hours of usage per week in column A and glance across to column B. Thus if you operate 40 hours per week the efficiency of your business is 24 per cent, as given in column B. To make full use of your business property you must use it all the time. The average home is much more efficiently employed than is the average business property. The average church has an efficiency of less than 10 per cent. This matter of efficiency is well worth bearing in mind before making that next important purchase. Can you get along without a new building, a new office, a new machine, or a new what not, by making your present business more efficient? Maybe you can. This chart will help you figure it out.

Important Facts About Nuts

A nut's purpose is to load the bolt in tension for a tight joint. For this, it is given shear strength greater than the breaking point of the bolt; and sufficient bearing area to avoid crushing or flow of the bearing surface with consequent reduction of tension.

★ ★ ★

While the thread form of a nut is accurate, its "lead" cannot, for practical purposes, be made identical with that of the bolt. Thus, a nut is made from material plastic enough to allow the threads to deform upon tightening and thereby adjust to distribute the load over many threads rather than concentrate it on the first few.

★ ★ ★

The standard "Finished" nut series satisfies the requirements. It gives not only the required bearing area, but also enough section for proper strength and to minimize the spreading or dilation of a nut when loaded. (The standard "Heavy" nut series is called for only when bolt holes have large clearances, or for high bolt loads.)

★ ★ ★

As a good general guide to follow, use nuts that are:

1. **Made to Am. Std. dimensions;**
2. **Made from soft, ductile material;**
3. **Strong enough to break the bolt or screw with which it is used. This would determine whether "Finished" or "Heavy" series is selected.**

—Courtesy of Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y.

Welded Wire Mats Save in Building Construction

A new method of constructing floors has been used successfully in a luxury 12-story apartment house, The Hawthorne, in New York City.

★ ★ ★

Lower costs and faster erection has resulted from the use of mats of heavy welded wire fabric for reinforcing concrete floors. These mats, many as large as 10′ x 20′, replace individual steel bars previously used that had to be placed piece by piece and tied into position.

Bundle of prefabricated mats being delivered to a floor for reinforcement. * * * * *

Another advantage reported was that electricians, carpenters and, later, concrete workers could do their respective jobs without concern for displacement of bars that had been so carefully spaced into position. Use of wire also reduced the amount of steel from 5.2

(*Please turn to page* 888)

IDA Elects Officers

The Industrial Diamond Association of America, Inc., Pompton Plains, N. J. at its 14th Annual Meeting and Convention in Williamsburg, Va. elected the following officers to serve for the coming year: As President, **Donald J. Wallace,** Wheel Trueing Tool Co., 3200 W. Davison Ave., Detroit, Mich.; as First Vice-President, **Bernard Jolis,** U. S. Industrial Diamond Corp., 589 Fifth Ave., New York 17, N.Y.; as Second Vice-President, **Leopold H. Metzger,** Super-Cut, Inc., 3418 N. Knox Ave., Chicago 41, Ill.

★ ★ ★

Directors elected for the following two years were: **Charles Baumgold,** Diamond Tool Research Co., Inc., 380 Second Ave., New York 10, N. Y.; **Donn E. Stone,** J. K. Smit & Sons of Mich., Inc., 9105 Macomb St., Grosse Ile, Mich.; **Jan Taeyaerts,** Precision Diamond Tool Co., Box No. 274, Elgin, Ill.; **John Van Itallie,** The Van Itallie Corp., 70 West 40 St., New York 18, N. Y.

Out-going President, **Morris Winston,** Diamond Drill Carbon Co., 244 Madison Ave., New York 16, N. Y. will also serve as Director for the coming year. Directors elected last year will remain in term for one more year.

★ ★ ★

The Convention opened on May 11 with Committee meetings and a meeting of the Board of Directors, followed by the Officer's Reception and dinner. The Membership met in General Session and discussed many activities of vital interest to the industrial diamond industry on May 12. A Technical Session followed elections, and a paper was given by **R. G. Weavind,** Director of Research, Diamond Research Laboratory, Johannesburg, South Africa, entitled "Factors Affecting the Efficiency of Resin-Bonded Diamond Grinding Wheels".

★ ★ ★

The Annual Reception and Banquet was held on May 14 during which the Installation of Officers, awarding of Certificates of Appreciation, and Tournament Prizes, took place. Music, dancing, and special entertainment followed the Banquet. Mr. Weavind was the guest of honor.

Bulletin on New Wire Straightening and Cutting Machine

A new wire straightening and cutting machine, the Vaughn Motomatic, is described in this 8-page bulletin issued by **The Vaughn Machinery Company.** The machine is specially designed to deliver uniform lengths of straight, precision-cut wire at variable speeds up to 300 ft per min. A caterpillar chain feed assures positive feed, eliminates twist, and reduces scrap to a minimum.

★ ★ ★

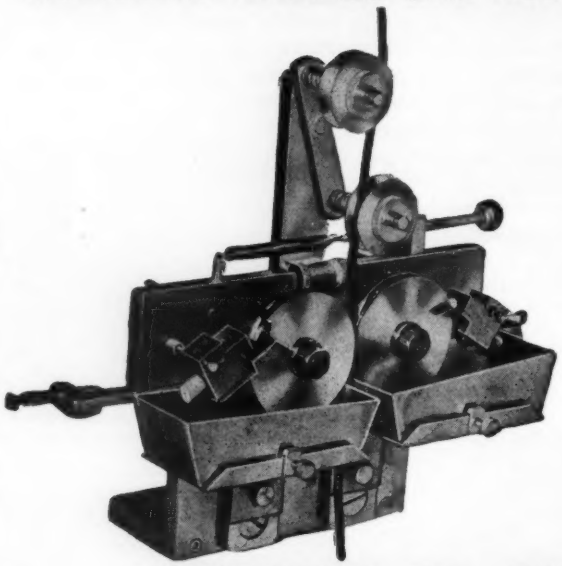
The first Motomatic model—No. 75 with ¾" capacity—in a projected line of these machines, is fully described in the bulletin. Full length views and closeups of various parts of the 21'6" machine are included, along with complete engineering data and specifications

LEGEND LARGE AND CLEAR ON INSULATED WIRE SURFACES — USE GILLIES MARKING

GILLIES CONCAVE AND FLAT MARKING WHEELS PRINT YOUR

WHEELS AND MACHINES FOR BEST WIRE IDENTIFICATION

MARKING WHEELS and MACHINES for ELECTRIC WIRE



Gillies Engraved Concave and flat marking wheels are widely used printing the I.P.C.E.A. color code, numerical, semi-spiral striped, dating, or manufacturer's identification, etc. on insulated wire, tubing or hose.

Machines print on ONE or BOTH SIDES in large legible letters. Wheels are adaptable to any machine—or we will supply the machines.

Wheels, shafts, ink pans and all accessories are readily removable for quick and easy cleaning.

Wheels are made of TOOL STEEL, HARDENED to Rockwell test 61-64 and HARD CHROME PLATED.

Send for samples of wire and prices on wheels and equipment.

"There is no substitute for QUALITY when combined with SERVICE"

DUNCAN M. GILLIES CO., INC.

P. O. BOX 181, WEST BOYLSTON, MASS.

Telephone: TE 5-4445

on all electrical and mechanical components, together with quick-loading safety reel and extension and run-out table.

★ ★ ★

Other Motomatic features, described in the bulletin, include an electric variable speed drive, an adjustable center straightener arbor, Timken roller bearings and taper-lock bushings on feed and straightener rolls, and an accurately synchronized flying shear cut-off.

★ ★ ★

Copies of Bulletin 751 may be obtained by writing The Vaughn Machinery Company, Cuyahoga Falls, Ohio.

Excellently Managed Firms

The American Institute of Management has certified the following concerns to have been "Excellently Managed" in 1958. The citations are based on the Institutes appraisal of these corporations, with respect to productivity, shareholders interests, employee benefits and community relationships.

Anaconda Wire and Cable Company
Belden Manufacturing Company
Bostitch, Inc.
Bridgeport Brass Company
Ekco Products Company
Fansteel Metallurgical Corp.
General American Transportation Corp.
The Gillette Company
The International Silver Company
"Montecatini"
Mueller Brass Co.
National Lead Company
H. K. Porter Company, Inc.
Revere Copper and Brass, Inc.

Silicone Selector Chart

A new General Electric Silicone Rubber Selector Chart, CDS-145, is now available from the Silicone Products Department, **General Electric Company,** Waterford, N.Y.

★ ★ ★

One of the most complete silicone rubber specification guides available today, this publication is designed to assist designers and engineers in selecting the proper type of silicone rubber for their particular requirements. The publication contains comprehensive data on applications, typical properties, primary classes and standard industry and military specifications.

Wire Men Who Want **Reel** Service

Call **APCO MOSSBERG** *First!*

Any size, any shape, any time! Apco Mossberg steel reels, spools and bobbins are designed exactly the way you specify, delivered on the day you specify.

Whether it's for drawing, stranding or any other type of processing . . . each Apco unit is custom-made to extremely close tolerances to run true without wire breakage or trapping. Each keeps machine downtime to the minimum . . . gives you a steel-strong, easy-spooling production package that pays off in on-the-line economies.

Tell us your wire or wire handling problems. Apco's engineers, experience, and 50 years of reel service will come up with an answer that makes real sense. Write, wire or phone collect.

PACIFIC COAST REPRESENTATIVE:
Gordon Proffitt
World Trade Center
Ferry Building
San Francisco 11, California

CANADIAN REPRESENTATIVE:
Hugh P. Williams & Co.
47 Colburne Street, West
Toronto, Ontario, Canada

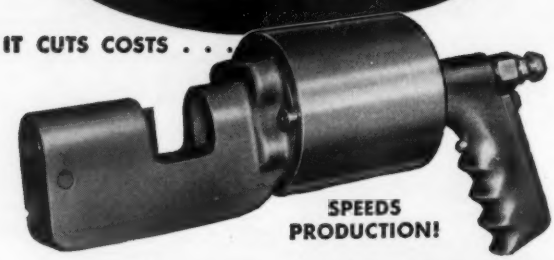
APCO MOSSBERG COMPANY
LAMB STREET, ATTLEBORO, MASSACHUSETTS

HOW TROUBLE-FREE ARE YOUR ROD and BAR CUTTING OPERATIONS?

Check them with the —

HKP PORTER *Hydraulic*
ONE-HOSE ROD and BAR CUTTER

IT CUTS COSTS . . .



SPEEDS PRODUCTION!

If your rod and bar cutting costs are sky-high why not look at the PORTER HYDRAULIC ROD and BAR CUTTER. Steel mill men who size it up usually put it to work — because one or more combination of the 3 Cutterheads and 5 Power Units, turns out to be the team that speeds their output, slashes their costs. Here's why:

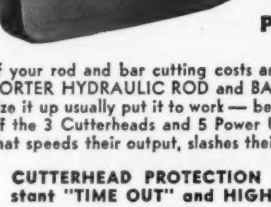
CUTTERHEAD PROTECTION — that eliminates constant "TIME OUT" and HIGH MAINTENANCE COSTS!

- **LONGER BLADES** with more bearing surface and rigid alignment eliminate side thrust and blade breakage.
- **FILTERED AIR** taken into the cylinder is forced out around the movable blade on each cut — eliminates the danger of dirt reaching bearing surface causing oil leakage and wear.
- **CONCENTRIC DESIGN** eliminates excessive wear of cylinder wall and ram.
- **LARGER CYLINDER AREA** allows the tool to cut capacity stock at a lower operating pressure, resulting in longer life for seal and hose.
- **SAFE, 12 VOLT CONTROL SWITCH** at the cutterhead gives instant finger-tip performance.
- **"KEY-POINT"** wear and replacement reduced to the minimum because of these exclusive HKP features.

A TRUE HYDRAULIC SYSTEM with these efficient, maintenance-saving features:

- **CONTROL VALVE** big and accurate enough for all industrial work. Solenoid operated.
- **EASY TO CHANGE RESERVOIR TYPE 10-MICRON OIL FILTER.**
- **PLUS** many other exclusive HKP features.

Ask to have a Porter Engineer tell you how the 3 CUTTERHEAD sizes and 5 HYDRAULIC POWER UNITS can provide the exact combination for your requirements.



OR — WRITE FOR COMPLETE PORTER HYDRAULIC ROD and BAR CUTTER FOLDER.

ATTENTION! Production and Quality Control Depts. Ask about our **NEW UPSET TESTING MACHINE!**

H. K. PORTER, INC. Somerville 43, Mass.

New High Drawing Speeds Attained by English Firm

Barron & Crowther, Ltd., Eastleigh, Hampshire, England, has developed a series of new high-speed wire drawing machines that are drawing high carbon steel wire at considerably increased speeds.

★ ★ ★

To cover finished wire sizes in a range of .054 to .010 inches in diameter, the machines have been developed of 18, 12, and 8 diameter.

★ ★ ★

Prior to the installation of these machines, the Speedwell Wire Co., Ltd., had been drawing wire at 2000 fpm. With the new machines, the following results have been obtained:

18" machine:
Inlet size: .160" max.
Finished size: .054/.037"
Speed: 3000 fpm.

12" machine:
Inlet size: .116" max.
Finished size: .037/.021"
Speed: 3500 fpm.

8" machine:
Inlet size: .072" max.
Finished size: .020/.010"
Speed: 3500 fpm.

★ ★ ★

Speedwell reports that the quality of the wire drawn at these speeds is superior to that of wire drawn when speeds were only 300 feet per minute.

Lee Wilson Buys Interest in Steel Equipment Co.

The Lee Wilson Engineering Company, manufacturers of heat treating equipment, has purchased a substantial interest in the **Steel Equipment Company,** makers of steel processing machinery. Both concerns are located in Cleveland, Ohio.

★ ★ ★

The affiliation will enable the Lee Wilson firm to coordinate its engineering work with that of "Seco" in the designing of equipment for the steel and wire industries.

★ ★ ★

One of the first jobs undertaken by Seco was the construction of a coiling unit for a large coil annealing system for the Irvin Works of the U. S. Steel Corp.

"Better Ways to Package, Unitize and Ship"

The 19th Edition of this catalog, published by the **Signode Steel Strapping Company,** is crammed with ideas for improving packaging and shipping methods in all industries.

★ ★ ★

This easy-to-read 48-page booklet is free to those interested and also contains Signode's complete line of strapping, tools, and equipment.

★ ★ ★

A helpful reference for anyone who ships, a free copy may be obtained by writing to the Signode Steel Strapping Co., 2600 North Western Ave., Chicago 47, Ill.

To Sell Carboloy Products in Eastern Area

Appointment of the **Brian Supply Company,** Providence, as an authorized distributor of Carboloy cemented carbide products has been made by the Metallurgical Products Department of the **General Electric Company,** Detroit. The company will stock Carboloy toolholders, blanks, wheel dressers, masonry drills, and carbide tools.

★ ★ ★

The company is at 111 Chestnut Street. Its territory includes Rhode Island, eastern Connecticut, and southeastern Massachusetts.

The German Wire Industry

A new book entitled "The German Wire Industry" by **Karl Heinz Freitag** has been published in Germany by Draht-Welt.

★ ★ ★

The book, in German, contains 155 pages of text, plus a supplement of statistics on markets for wire and wire products. The first section is devoted to the creation of the wire industry within the framework of the iron and steel industry, describing the place of wire in the field, the technical aspects of the wire industry, the changes that have come about with changing times and the effect of these changes as to classes of products. The relation of production costs to

For Moisture Resistance, Specify

TEXTILENE

TWI-FLEX and TWI-WAX

Treated to reduce wicking and prevent leaching, lightly waxed Textilene Twi-Flex and heavily waxed Textilene Twi-Wax provide effective resistance to moisture. Both fillers are extensively employed for non-metallic sheathed cable (building wire), maritime shipboard cable, varnished cambric cable, and underground service entrance cable.

Twitchell's superior Textilene line also includes: Soft, dry fillers — *Twi-Port* and *Glascor** (Fiberglas-centered for high tensile strength without added bulk). Used for control, power, appliance, coaxial and communications cables, and all portable and flexible cords. Fungus-resistant filler — *Twi-Tar.* Used for buried communications cable, expanded ACSR cable, and in other applications.

*Patent Applied For

For Every Wire and Cable Application
Twitchell's TEXTILENE Fillers Fill The Bill

Quality-controlled materials that are dependably uniform . . . in standard forms, or customized to special needs.

Initial low cost with savings added by production efficiency . . . flexible, ready-to-use fillers that fit all equipment, handle and form easily, always maintain desired shape.

Assured supply from a reliable domestic source . . . always available in economical and convenient packaging.

Proved performance as components of cables and wires that meet government specifications . . . stability shown by trouble-free installations in continuous service 20 years and longer.

FREE — SAMPLE SPOOLS of any type of Textilene filler to demonstrate the superiority of Twitchell materials in your operation—also technical counsel without cost or obligation. Just tell Twitchell your end-use requirements. *Write, wire, or phone today:*

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PAPER PRODUCTS FOR THE WIRE INDUSTRY

Twisted • Folded • Pressed • Crushed • Shaped • Braided • Woven

EFFICIENT, MODERN SYSTEMS
FOR
ELECTRICAL WIRE & CABLE MANUFACTURING

• *CABLE LACQUERING SYSTEMS*

Conventional cellulosic, or other type, lacquers are applied in successive continuous coats from one to twenty-eight coats over fibrous braid wrapped primary conductors. One end, four ends, or eight ends of wire are handled continuously. System includes letoff, application, drying and constant tension takeup equipment.

• *WIRE ENAMELING SYSTEMS*

Natural and synthetic enamels, silicones, solution nylon, modified plastisol, and similar insulating coatings are applied to bare, cotton or glass covered wire in round, square or rectangular cross section. Ten or twenty simultaneous strands are handled. Systems are complete with letoff, preannealer, application system, capstan and multiple takeup unit.

• *ASBESTOS INSULATING SYSTEMS*

Carded asbestos is applied to continuous single conductor as an integrated operation with saturating, rotary forming, drying, cooling and polishing of the finished wire. Wire from No. 20 gauge to No. 6 AWG is handled through an asbestos wall thickness range of from .008″ to .040″ thickness in a single pass.

• *RUBBER OR PLASTIC JACKETING SYSTEMS*

Rubber and thermoplastic jacketing compounds are continuously applied to electrical wire or cable by the extrusion method. High speed, constant tension letoff and takeup equipment, controlled cooling or continuous vulcanizing equipment are powered by synchronized range drives as complete, integrated wire handling systems. Extrusion machines of customer's choice are furnished.

• *GLASS & VARNISH COATING SYSTEMS*

Double layer of glass or cotton wrapping is applied to round, flat or square conductor. Two individual coatings of high temperature varnish are applied and the finish baked in a continuous operation. Units are complete from letoffs to takeup frames.

• *SELF TRAVERSING REEL CORD DRYERS*

These ingenious machines are used to remove hygroscopic moisture from fibers, braided or knitted flexible cable. These machines increase extrusion speeds, reduce blister scrap loss and improve diameter control. They are easily installed in existing extrusion line.

TECHNICAL INFORMATION ON ANY OF THESE PROCESSES UPON REQUEST

C. A. LITZLER CO., INC.
235-239 BROOKPARK ROAD
CLEVELAND 9, OHIO

the size of a plant is discussed. Relationship of plant size to markets is covered. And the trends of the industry are set forth.

★ ★ ★

The second section is largely historical and is divided into three periods—1880 to 1918, 1919 to 1945 and 1946 to the present. In this the author tells of conventions, associations and so forth, not only in Germany, but other countries. In 1945 the big cartels were broken up and the new method of conducting industry-wide affairs is described. In this the matter of price structures with relation to production, of tariffs and government regulations to facilitate exports are set forth.

★ ★ ★

A final section treats of the problem of Europe as an economic unit and the need for international cooperation to guide and control the functioning of production.

★ ★ ★

Copies may be secured by writing Dracht-Welt, Jahnstrasse 36, Dusseldorf, Germany. The price is DM 23.60.

Adds Line of Cap Nuts

The Jacobson Nut Mfg. Corp. announces that its plant in Kenilworth, N. J. is currently manufacturing cold headed Cap Nuts. They are produced by highly automated equipment, resulting in a low cost, quality product,which are available in steel, brass and aluminum. Sizes: #4 through ½″

★ ★ ★

For further information, engineering assistance and samples, inquiries should be addressed to the Jacobson Nut Mfg. Corp., Box 177, Kenilworth, N. J.

Wire Firm Moves to Mass.

Randy Wire Works, Inc., formerly of North Bergen, N. J., has announced that it moved its offices and plant to new and larger quarters on May 1, 1959, to 122 Federal St., Northampton, Mass.

★ ★ ★

The Company specializes in fine sizes of stainless steel and alloy wires of many types and feels that its new facilities will enable it to render better deliveries and service.

Outstanding Personalities of the Wire Industry

Dr. Nassau to Address Association in October

Walter B. McShane, Chairman, Wire Committee, **American Steel & Wire Division, U. S. Steel Corp.**, General Program Chairman for the Annual Convention of The Wire Association, which will meet in Cleveland October 12-15, 1959, has announced that **Dr. Jason J. Nassau** will be the principal speaker at the annual dinner on Wednesday evening, October 14.

* * *

Dr. Nassau is one of America's foremost astronomers, professor and head of the Department of Astronomy and director of the Warner & Swasey Observatory and the Nassau Astronomical Station of the Case Institute of Technology. A native of Smyrna, Asia Minor, he is a graduate of Syracuse University, from which institution he holds degrees of Master of Science and Doctor of Philosophy. The University conferred upon him an honorary degree of Doctor of Science in 1940 and he received in 1956 a degree of Doctor of Laws from Lake Erie College.

* * *

While the title of his talk has not been announced, it is understood that it will cover astronomy, the missile program, and possibly something about space travel. Our distinguished guest, who has a long list of notable achievements to his credit, will deliver a most unusual and worthwhile address—one that will be entertaining, informative, and timely. Be sure to be present for it!

Joins Kaiser's Bristol Works

A. L. Rosener, Jr., formerly Process Development Engineer in the Electrical Wire Division of **John A. Roebling's Sons Corp.** in Trenton, N. J., has been appointed Technical Superintendent of the Bristol Works of the **Kaiser Aluminum & Chemical Corporation in Bristol, R. I.**

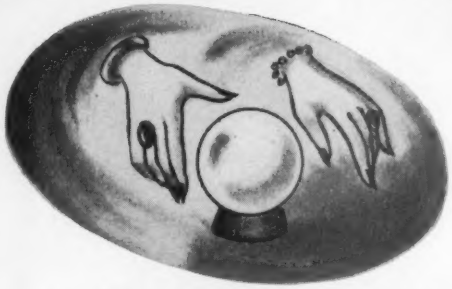
* * *

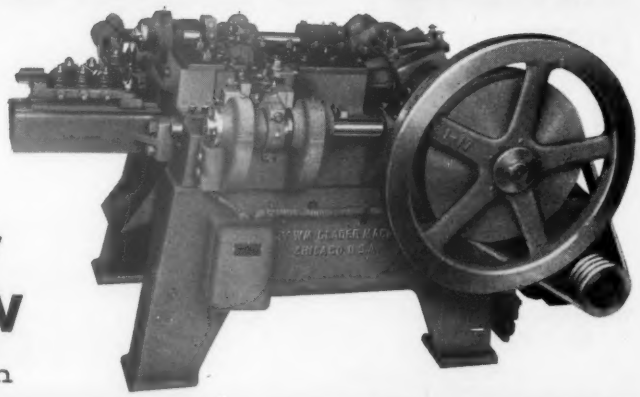
Mr. Rosener presented a paper at the Annual Convention of **The Wire Association** in 1957 entitled "Continuous Vulcanization of Butyl Rubber Insulated High Voltage Cable" in which he described a new vertical extrusion and vulcanizing process that had been installed at Roebling's Buckthorn Works in Trenton.

J & L Announces Wire Rope Sales Managers

Designation of sales territories for the Wire Rope Division of **Jones & Laughlin Steel Corporation** and the appointment of six

IF THERE'S A NAIL MACHINE IN YOUR Future make it a GLADER





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AVAILABLE NOW
Write for 12 Page Bulletin

Wm. GLADER MACHINE WORKS 210 N. RACINE AVENUE CHICAGO 7, ILLINOIS

EXPORT DEPT. 122 EAST 42ND STREET • NEW YORK 17, N. Y.

area sales managers were announced today by **P. P. Somerville,** Division General Manager. All appointments became effective June 1.

★ ★ ★

The appointments are:

B. C. Brooking, 1824 Pine Street, New Orleans 10, La., Area Manager for the Southeast Territory with headquarters in New Orleans.

W. H. Hickman, 3209 Arapahoe Road, Pittsburgh 34, Bethel Boro, Pa., Area Manager for the Central Territory with headquarters in Pittsburgh.

D. D. Hyland, 824 South Grant Street, Hinsdale, Ill., Area Manager for the Midwest Territory with headquarters in Chicago.

Marshall Olds, R. D. 1, Hughesville, Pa., formerly Division Sales Service Engineer, Area Manager for the Northeast Territory, with headquarters at Muncy.

R. O. Salley, 2210 Bissonnet, Houston 5, Tex., Area Manager for the Southwest Territory with headquarters in Houston.

J. E. Weigel, 15801 Canal Road, Mt. Clemens, Mich., Area Manager in the North Central Territory with headquarters in Detroit.

Branch Manager Appointed By Carpenter

Marvin L. Duggins has been appointed branch manager of the St. Louis Territory of **The Carpenter Steel Co.** He had been a sales representative for Carpenter in that area.

★ ★ ★

Mr. Duggins, who joined Carpenter in 1953, assumes responsibility for sales management in the St. Louis Territory in addition to management of the firm's branch warehouse there.

To Sell in N.Y.C. Area

The appointment of **Edward J. Mammana** to the New York district office of **Riverside-Alloy Metal Div., H. K. Porter Co.,** has been announced by **F. H. Conant,** General Sales Manager of the Porter Division.

★ ★ ★

Mr. Mammana, who joined Riverside-Alloy last February, was associated previously with Crucible Steel Company in a sales-service capacity. In his new assignment, he will cover portions of the New York City area from the Division's office in East Orange, N. J. A graduate of Seton Hall University, he also completed a special course in metallurgy at Temple University.

To Sell Utica Drop Forge Equipment

Howard A. Edick has been named sales representative for the **Utica Drop Forge and Tool Div.** of the **Kelsey-Hayes Co.** in Virginia, Tennessee and the Carolinas, according to **F. L. Marshall,** sales manager. He will represent the company for its line of hand tools.

★ ★ ★

Mr. Edick has been with the organization in the home office for the past four years. He assumed his duties in May, with headquarters in North Carolina.

Y S & T Appointments

Leo DeFiore has been appointed director of engineering and **Carl J. Lucas,** chief engineer, **The Youngstown Sheet and Tube Company's** general manager of steel operations, **Harold E. Engelbaugh,** has announced.

LOW COST precision wire plating

MAINTAIN UNIFORM COATINGS AT HIGH SPEEDS!

CONTINUOUS ELECTROPLATING EQUIPMENT

This low cost equipment performs with ease and efficiency that mean real savings. Preset quality control insures perfection without depending on operators' skill. No toxic fumes, clean operation at low temperature, elimination of work hardening during processing and many other features are the result of experience and sound engineering that go into the design of all Universal equipment.

We furnish complete installation . . .
For further information write to:

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SECAUCUS, NEW JERSEY SOLE AGENT IN CANADA: E. V. LARSON CO., LTD., TORONTO, CANADA

U. S. PATENT #2823180 AND FOREIGN PATENTS PENDING

Mr. DeFiore, chief engineer for the company since January 1, 1956, is a native of Italy. He attended Ohio State University for special studies. Mr. Lucas studied at Miami University. He joined the company in 1946.

Scovill Elects V-P

John J. Hoben, works manager of the Mills Division of **Scovill Manufacturing Company** has been elected to the newly-created post of vice president and operations manager of the division.

★ ★ ★

Seldon T. Williams was re-elected president and general manager for his first full term. All other top executives were also elected.

★ ★ ★

The new vice president, Mr. Hoben, joined Scovill in 1929 following his graduation from Yale University. He was appointed general superintendent of the mill departments in 1945, following his gradual rise in various supervisory positions. He became works manager in 1949.

Joins Narragansett Wire

Urbain J. H. Malo has been appointed Technical Director of the **Narragansett Wire Company,** Pawtucket, R. I. He had held a similar position with **The Crescent Company.**

★ ★ ★

Narragansett Wire, besides having a plant in Taunton, Mass., also owns and operates the **Jordan-Rogers Company** of Orange, Calif., and the **Texas Wire & Cable Company** in Plano, Texas.

★ ★ ★

Mr. Malo is well-known in the wire and cable industry and will be particularly recalled by many for his very successful planning of the Regional Meeting in Boston, held at The Statler Hotel on April 29 and 30, which drew an attendance of over 300 wire men. He was the program Chairman.

★ ★ ★

He is a director of The Wire Association and a member of the Electric Wire and Cable Committee, which functions on all matters pertaining to Association meetings arranged for this branch of our industry.

A S & W Appointment

William P. Keefe of Cleveland, O., has been appointed assistant manager of sales in the St. Paul district sales office of U. S. Steel's **American Steel and Wire Division,** it is announced by **Archie M. Marsh,** manager.

★ ★ ★

A native of Waukegan, Ill., Mr. Keefe completed his high school education there and attended Wabash College and Miami University where he obtained his B.S. degree in industrial management in 1946. He also attended the Cleveland College for graduate study in management.

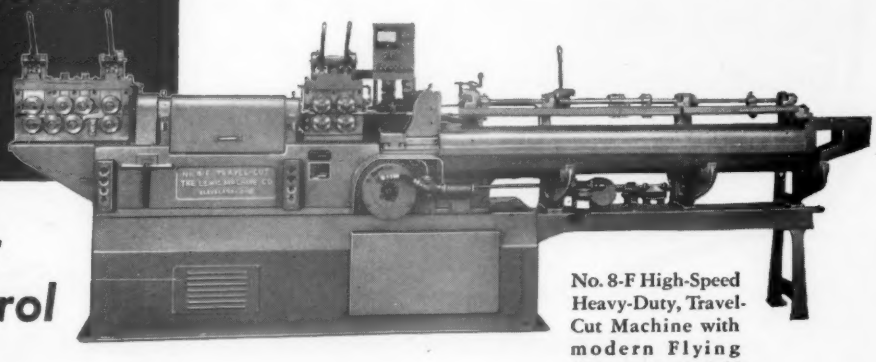
★ ★ ★

Mr. Keefe started his career with American Steel and Wire as a tester helper at its Waukegan

WIRE STRAIGHTENING AND CUTTING with Air Clutch and Air Brake

for better quality control

● Greater accuracy with a minimum of spot swell is achieved through three important improvements on the famous Lewis Travel-Cut Wire Straightening and Cutting Machines . . . Wichita Air Clutch and Brake and Reeves Variable Speed Drive. There are 34 models in the Lewis line from .012" to ¾" rounds and shapes at speeds up to 200 FPM. Write for new brochure.



No. 8-F High-Speed Heavy-Duty, Travel-Cut Machine with modern Flying Shear Cut-Off Mechanism. Handles 5/32" to 3/8" dia. wire at speeds up to 200 FPM.

THE LEWIS MACHINE COMPANY

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Works in 1940. He has held various positions in the company's mills and offices and at the time of this promotion was assistant manager, commercial research department.

Auto-Lite Administrative Changes

The Electric Auto-Lite Company announced that the Board of Directors has elected **James P. Falvey** chairman of the Board and **Robert H. Davies** president and a director.

★ ★ ★

Mr. Falvey has served as president of the company for five years and has been connected with Auto-Lite for twenty-five years. Mr. Davies has been associated with **Clark Equipment Company** of Buchanan, Mich., as vice president.

★ ★ ★

Gurdon W. Wattles, former chairman of the Board, was named chairman of the executive committee, replacing **C. Russell Feldmann.** Mr. Feldmann will continue to serve as a director and a member of the executive committee.

To Sell Silicones in Michigan

Joseph C. Allwarden has been appointed sales representative for the Michigan Territory of the Silicone Products Department, **General Electric Company.** His office location is 2211 Woodward Ave., Detroit 1, Mich.

★ ★ ★

A 1951 graduate of Manhattan College with a Bachelor of Science degree in Electrical Engineering, Mr. Allwarden joined General Electric in 1955 and has worked in the Medium Induction Motor Department and the Small A.C. Motor and Generator Departments. He succeeds **J. R. Gordon.**

Heads Rubber Development for GE

Walter J. Dugan, Jr., has been appointed Manager-Rubber Market Development for the Silicone Products Dept. of **General Electric Company** by **Robert T. Daily,** Manager-Marketing. In this new position, Mr. Dugan will direct market research, sales planning and technical service for the department's silicone rubber product line.

★ ★ ★

Mr. Dugan graduated from Rensselaer Polytechnic Institute in 1943 with a degree in chemical engineering. He received his master's degree in chemical engineering in 1948. He will continue to be located at headquarters of the Silicone Products Department, Waterford, New York.

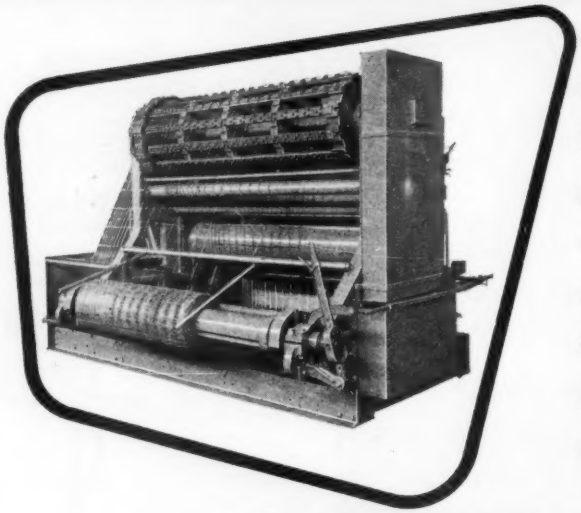
Joins Amchem Research Staff

Amchem Products, Inc., Ambler, Pa., manufacturer of chemicals for industry, has announced that **Dr. Louis Schiffman** has joined the firm and has been assigned to the company's Metalworking Chemicals Division. He will do research and product development work.

★ ★ ★

Dr. Schiffman came to Amchem from the Atlantic Refining Com-

Interlocking FENCE LOOMS



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- Low Maintenance Cost
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- Replaceable Main Bearings
- Single or Double Strands
- Years of Low Cost Production

Write for Detailed Information — Without Obligation

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Specialists In Fence Looms

pany where he was a member of the research and development department. For two years prior to this he was with DuPont's organic chemicals department. He attended New York University from which he obtained his B.S. degree in chemical engineering in 1948. After graduation he worked as a research engineer for the Pennsylvania Grade Crude Oil Association, Bradford, Pa. He acquired his M. S. in 1952 and his Ph.D. in physical chemistry in 1955, both at New York University

To Manage Fastener Plant

Announcement has been made of the appointment of **Stanley C. Adamek** to the post of General Manager of the **Pheoll Manufacturing Company,** 5700 Roosevelt Rd., Chicago 50, Illinois. Mr. Adamek joined the company six years ago and had been successively plant manager, works manager and assistant general manager. Pheoll is a major producer of bolts, nuts, and other fasteners.

To Wind Association Clock

The handsome grandfather clock that graces The Wire Association's headquarters in Stamford, Connecticut, will be wound again in October for the ensuing year.

★ ★ ★

The Association is happy to announce that **Mr. Douglas Gledhill,** Director of J. & A Binns, Ltd., Halifax, England, has accepted an invitation to perform this function traditionally done by a member from England.

★ ★ ★

The antique clock was presented by **John Rigby,** Director of **John Rigby & Sons Ltd.,** Bradford, England, in 1948, on behalf of our British Association members.

Textile Machine V.P. Retires

After more than 53 years of leadership in the Braiding Industry in the employ of **Textile Machine Works, Norman E. Richards,** vice president in charge of braiding, has announced his retirement.

★ ★ ★

Mr. Richards came to Textile on February 8, 1906 as assistant to the late **Ferdinand Thun,** one of the founders of Textile, who was then Secretary-Treasurer of the company. He was named vice president in 1948.

★ ★ ★

Donald L. Young, assistant manager of Textile's Braiding Machine Division since 1954, will succeed Mr. Richards as manager of the division. A graduate of the Wharton School, University of Pennsylvania, he joined the company in 1931.

Alcoa Sales Appointment

Robert W. Adams has been appointed manager of wire sales for **Aluminum Company of America.**

★ ★ ★

Mr. Adams will coordinate the company's sales and service policies with aluminum wire custo-

NOW!...14 NEW AND EXCLUSIVE FEATURES FOUND ONLY IN HIGH-POWERED ENJACO

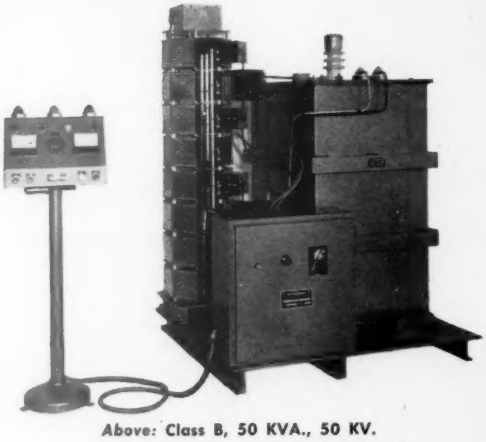
HIGH POTENTIAL

TESTERS!

Write today for our Catalog Section 15 and see why Enjaco High Potential Testers outperform any previously available to the industry!

SIZES FROM

1 TO 50 KVA. 5 TO 150 KV.
115 TO 550 V. SUPPLY, SINGLE PHASE.
CORONA-FREE, AND 50, 75 OR 100% DUTY-RATED TRANSFORMERS OPTIONAL.



Above: Class B, 50 KVA., 50 KV.
Left: Class A, 10 KVA., 10 KV.

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230 Shaw Road
South San Francisco, Cal.

mers. Since the wire business is becoming an increasingly important segment of Alcoa's semi-fabricated product sales, Mr. Adams will work closely with existing and potential wire customers.

★ ★ ★

He joined Alcoa in 1947, and served for almost 12 years in the Atlanta sales office. He attended Alabama Polytechnic Institute at Auburn, where he received a degree in mechanical engineering in 1947.

★ ★ ★

Prior to this assignment, Mr. Adams devoted eight months to market research in the aluminum wire field for Alcoa.

J. & L. Appoints Chief Engineer in Detroit

R. H. Loutzenhiser, division vice president — production, Detroit Stainless and Strip Div., **Jones & Laughlin Steel Corp.**, Detroit, has announced the appointment of C. **Melvin Smith** as Chief Engineer of the division.

★ ★ ★

At the same time **John E. Timberlake**, J. & L's vice president—sales, announced the appointment of **Donald R. Roche** as Assistant Manager, Cold Finished Bar Products.

To Direct Research for Holden

Richard H. Church has been named director of research for **The A. F. Holden Co.**, Detroit, manufacturers of heat treating equipment and metallurgical supplies with supporting plant and warehouse facilities at New Haven, Conn., Milford, Mich., and Los Angeles, Calif.

★ ★ ★

His duties will include application tests of the Holden luminous wall heat treating furnace for industry and continuing research with the firm's new carbon potential system for controlling decarburization and scale formation in heat treated steels.

★ ★ ★

He received his education at Wayne State University and the University of Detroit, majoring in mathematics and chemistry, before joining Holden in 1953. He will headquarter in Detroit.

Charles S. Barningham

One of the earliest members of The Wire Association passed away recently—**Charles S. Barningham.**

★ ★ ★

Mr. Barningham began a long career of service to the wire industry when he joined the New England Butt Company of Providence, Rhode Island, as a draftsman in 1905.

★ ★ ★

He was appointed Chief Draftsman in 1919 and in 1925 was made Chief Engineer and in 1930 took on the added duties of Sales Manager. Shortly thereafter he was also elected a director of the company.

★ ★ ★

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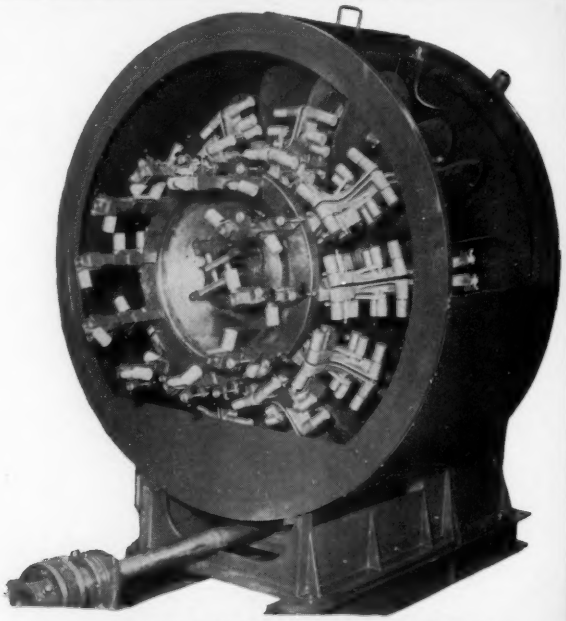
- **20 or 16 paper head**
- **16" or 20" disc diameter**
- **100-350 rpm**
- **4½" bore passage**
- **Constant tension**

- BETTER TENSION FEATURES
- LESS FLOOR SPACE
- LOWER INVESTMENT
- EASIER SURVEY



NEW POURTIER PAPER SERVING MACHINE

POURTIER MACHINES

76 à 82 Rue de la Fraternité

ROMAINEVILLE (Seine) **FRANCE**

New Hyprez Polishing Brushes For Diamond Compounds

For final polishing operations on dies, molds and gages, a new line of brushes has been developed by **Hyprez Division of Engis Equipment Company,** Chicago.

★ ★ ★

These brushes are made of finest natural stiff bristle for economical

HYPREZ POLISHING BRUSHES

and effective final finishing with diamond compounds; and are available in three shapes: end, wheel, cup. Perfectly centered shanks of two lengths permit the use of Hyprez brushes with either the straight or contra-angle handpieces of the Di-Profiler Reciprocating Hand Machine, or they may be used with equal efficiency with any type of rotary hand tool.

★ ★ ★

A catalog sheet showing all sizes, shapes and prices is available upon request from Hyprez Division, Engis Equipment Company, 431 S. Dearborn Street, Chicago 5, Illinois.

Folder on Tension Control

The Pneumatic Applications Co., Simsbury, Conn., has issued a booklet entitled "Automatic Tension Controller," in which is described an instrument of advanced design for the simple and positive control of wire or yarn tensions automatically.

★ ★ ★

Once the correct tension is set the device will register the tension on a dial and maintain the tension at this point thereafter. While originally designed for tension control in the textile industry, it has been found that the controller is ideal for wire and a number are now in use in this application.

★ ★ ★

Full details will be supplied by the manufacturer.

To Handle Export Sales for MPM

Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J., has appointed **Ballthrall Engineering Co.,** 1505 Race St., Philadelphia 2, Pa., as its export sales representative for all foreign sales, except for a few countries.

★ ★ ★

MPM manufactures extruding and auxiliary equipment, available as single machines or complete units for the insulation of wire and cable with thermoplastics. Ballthrall also supplies Teflon extruders for wire coating, compression and injection molding equipment, vacuum, mixing, dispersing, impregnating, and complementary equipment for complete plastic processing installations.

★ ★ ★

MPM recently moved to new quarters in Clifton, tripling the size of its facilities. New equipment is being added and the plant is expected to be in full operation by the end of the summer.

Standardize on ACROPAK* Spools!

Only ½ the Weight!

YET STRONG, TOUGH, RIGID . . *LONGER LIFE*

ACROPAK Spools will help you cut wire packaging costs because they give longer service, require less maintenance and cost less to ship. They're strong. They'll take repeated shippings and still run true on the arbor. They're machined to close tolerances. You can run them at high production speeds with fewer snags, less toe-out and minimum end breakage.

- Light Weight
- Precision built
- Reduced cost
- Longer life
- Extra strength
- Dynamic balance
- Greater production
- Low cost reconditioning
- Less maintenance
- Attractive packaging

THEY CUT YOUR SPOOLING COSTS

Best proof of ACROPAK superior performance are the millions of these spools now used by the biggest names in the wire industry. We've proved it to them—let us prove it to YOU.

★ We also make a complete line of heavy-duty shop processing STEEL SPOOLS built to the same high standards of accuracy and rigidity as the famous Acropak aluminum spools.

ACROMETAL PRODUCTS INC.
616 5th Street North, Minneapolis 1, Minn.

Suffering a heart attack in 1948 he resigned from the company, but upon his recovery, he became associated with a small machine company, where he spent his time when he was not out in a boat. Barney was an ardent yachtsman. During his more active years he was a regular attendant at Association meetings and was well and widely known throughout the industry.

Apex Alkali Adds to Staff

Apex Alkali Products Company, Philadelphia, Pa., has announced the appointment of **Leon P. Moynihan, Jr.** to their Sales Staff, serving the states of Massachusetts, Rhode Island, Maine and Vermont.

★ ★ ★

Mr. Moynihan is a graduate of Bryant College in Providence, is married and makes his home in Springfield, Mass. He served with the Armed Forces in Korea and

Leon P. Moynihan, Jr.

was formerly associated with General Electric Company.

★ ★ ★

This appointment in the New England area is made in addition to **A. B. Chauncy,** who is serving industry in the state of Connecticut and with headquarters in West Hartford.

Sjogren Acquires Rights To Die-Sizing Machine

The Sjogren Tool and Machine Co., Inc., Auburn, Mass., has recently acquired the sole manufacturing rights of an automatic Die Sizing Machine to be made under Patent #2,391,983.

★ ★ ★

Two models are to be manufactured—one a six-spindle, the other a single spindle of similar construction. The larger machine has a capacity of 300 Dies per eight-hour day.

★ ★ ★

Although these machines have been in use for a number of years, they have just very recently been made available as a whole to the Wire Industry.

★ ★ ★

The Difference
IS HERE.....
NEW MPS CONVOLUTE DURA CURL RIMS...
The difference between just any spool or reel and Superior MPS CONVOLUTE DURA CURL Rims is well worth your close attention. Because now, with this exclusive MPS feature, maximum strength and rigidity are obtained throughout the reel heads. You can now have continuous trouble free high speed winding, without spool straightening expense. These new MPS spools also have the famous No-Crev feature.
Ask about MPS CONVOLUTE DURA CURL RIMS today. We invite your inquiries.
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Spools & Reels
give you brute strength with dimensional precision, concentricity, and balance. Another patented MPS development engineered to help you!
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Division of Wanskuck Co.
#110

A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.
Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,884,825, WIRE CUTTER AND INSULATION STRIPPING APPARATUS, patented May 5, 1959 by Floyd G. Eubanks, Pasadena, Calif., assignor of ten percent to Robert M. McManigal, Pasadena, Calif.

There are 12 claims in this patent for apparatus which includes fluid-actuated grippers on opposite sides of cutters for gripping the severed portions of the insulated wire, and pneumatically-operated for bodily shifting the grippers away from each other prior to opening the cutters.

★ ★ ★

No. 2,885,164, CRIMPED CONNECTING BARS FOR WOVEN WIRE CONVEYOR BELT, patented May 5, 1959 by Fred L. Hooper, Cambridge, Md., assignor to Cambridge Wire Cloth Company, Cambridge, Md.

A crimped bar for connecting meshing transversely disposed coils of woven wire conveyor belt is disclosed, the alternate crimps of the bar being positioned to receive the arcuate ends of alternate convolutions of the coils, the bottoms or short radius surfaces of the crimps having transversely disposed grooves formed by tooth marks in the surfaces thereof, and the arcuate ends of the convolutions being nested in the grooves.

★ ★ ★

No. 2,885,693, SPRING ASSEMBLY, patented May 12, 1959 by Elmer T. Wuest, Cincinnati, Ohio.

Wire coil springs of hour glass shape are interconnected by elongated coil springs connected with the border frame members of the assembly, so as to position the border frame members in substantial vertical alignment with the major axial forces capable of being developed by the engaged coil springs when the springs are in loaded condition.

★ ★ ★

No. 2,885,710, SPRING FOR WINDSHIELD WIPER ARMS, patented May 12, 1959 by Joseph Brasty, Maple Heights, Ohio.

A single wire spring is provided for engaging a windshield wiper support arm. There are 4 claims.

★ ★ ★

No. 2,886,255, COIL WINDING MACHINE, patented May 12, 1959 by Wallis M. Tener, Torrance, Calif., assignor to Northrop Aircraft, Inc., Hawthorne, Calif., a corporation of California.

The wire coil winding machine includes a resilient deformable wiper member which comprises an elongated strip of material folded on itself to provide a return bend portion which is slit lengthwise to provide a pair of distinct edges which bear on the cylindrical surface of the coil form in parallel relation to the axis thereof, and are adapted to be moved longitudinally of the cylindrical surface; and a force producer adapted to exert a force on the wiper blade thereby causing the pair of distinct edges to exert a predetermined pressure on the cylindrical surface and the wire to be partially embedded in the pair of distinct edges during a winding operation.

★ ★ ★

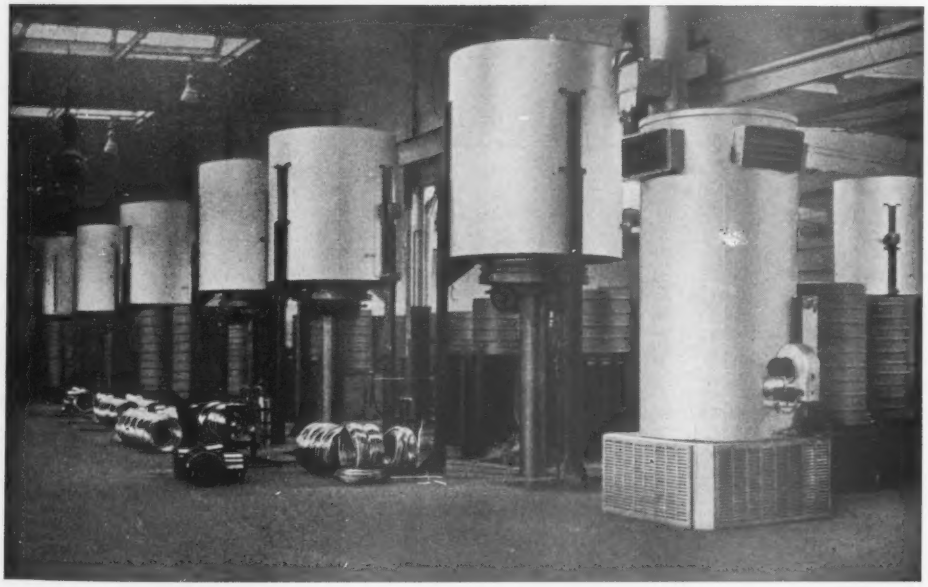
No. 2,887,147, FLATTENING DEVICE FOR COILED STRIP, patented May 19, 1959 by Karl Herman Reinhold Ficht, Detroit, Mich., assignor to Special Engineering Service, Inc., Detroit, Mich., a corporation of Michigan.

Provision is made to straighten coiled strip stock, including the outer coil end portion which is generally difficult to straighten.

★ ★ ★

No. 2,887,170, GARDENING TOOL,

THE LAST WORD IN MODERN, EFFICIENT DESIGN!



SEVERAL VACUUM BRIGHT ANNEALING UNITS WHICH WE HAVE INSTALLED IN ONE OF THE MOST PROMINENT CABLE WORKS IN GERMANY

(German and Foreign Patents)

★

SOLE REPRESENTATIVE:
PAUL REICHER
Machinery & Equipment
P. O. BOX 127
Willowdale; Ont., Canada

OFENBAU **FRITZ** G. m. b. H. & Co. K. G. **HAGEN,** (W.-GERMANY)

patented May 19, 1959 by Stephen V. Fenicchia, Rochester, N. Y.

A manually-operable combination tool for grading the soil by a back and forth movement is disclosed, the tool including a wire lattice body portion, connected by two end handles.

★ ★ ★

No. 2,887,702, WIRE CLEANER, patented May 26, 1959 by August J. Freitag, Union, N. J.

There are eight claims to this manually-supportable and portable wire stripping apparatus, including two rotating brushes, the spacing between their peripheries being manually varied as required.

★ ★ ★

No. 2,888,075, WIRE CUTTING MACHINE, patented May 26, 1959 by James W. Davidson, Chagrin Falls, Ohio, assignor to Thompson Ramo Wooldridge, Inc., a corporation of Ohio.

This patent relates to a pivoted wire cutter, work feeding, electrically-operated machine.

★ ★ ★

No. 2,888,214, COILING DEVICE, patented May 26, 1959 bv William J. Wilke, Baltimore County, Md.

The device is adapted to coil flexible members, as cable, rope and wire, into a combined reel and carton therefor. There are six claims.

★ ★ ★

No. 2,888,511, ELECTRIC CORD, patented May 26, 1959 by Kenneth E. Guritz, Geneva, Ill.

The cord comprises elongated conductor wires, a sheath of flexible insulating material enclosing the wires, a bead extending from one side of the sheath and of greater thickness remote from the sheath than closely adjacent thereto and a groove in another side of the sheath complementary to the bead to receive and grip the bead so that adjacent lengths of the cord can be secured together in side-by-side relationship.

New Catalog on Self-Aligning Roller Bearings

Chain Belt Company's Shafer Bearing Division announced the recent publication of Condensed Catalog 59A covering the complete line of Shafer Self-Aligning Roller Bearings.

★ ★ ★

The catalog is compiled to assist in the proper selection of bearing equipment for greater speed, higher load capacities, and longer wear life.

★ ★ ★

Catalog 59A is packed with factual information on Shafer bearing design, specifications, lubrication, seals, and installation features that protect your equipment. Copies may be obtained by contacting a Chain Belt Distributor or District Office, or by writing direct to Chain Belt Company, Sales Promotion Department, Milwaukee 1, Wisc.

Three Norelco Reprints Available

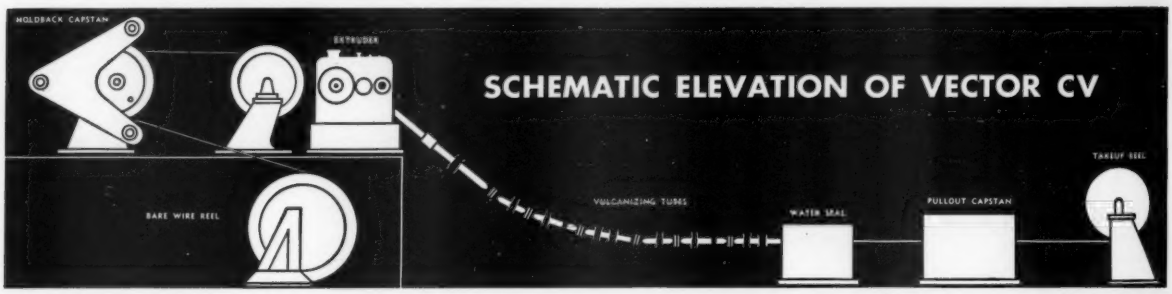
Articles on three different subjects, reprinted from national magazines, are now available from the Instruments Division, **Philips Electronics, Inc.**, 750 South Fulton Ave., Mount Vernon, N. Y.

★ ★ ★

Reprint #1 is titled "Measuring X-ray Diffraction Speeds Scale Analysis" and deals with the problem of analyzing scale deposits from boilers and heat exchangers in order to select the proper solvents for cleaning operations.

★ ★ ★

Reprint #2 is titled "Why X-rayed Diamond Tools?" and discusses the method for orientating



SCHEMATIC ELEVATION OF VECTOR CV

FOR RUBBER COVERED WIRE AND CABLE VECTOR CV

VECTOR CV with special new double seal combines the advantages of horizontal and vertical CV without the disadvantages of either. Check these important features:

- **QUALITY**—wire and cable is completely supported externally to prevent scuffing and distortion.
- **SPEED**—full cycle of vulcanizing and pressure cooling assures production speeds commonly associated with horizontal CV.
- **VERSATILITY**—Positive support and full length of vulcanizing tubes assures economical production of a wide range of cable.
- **ECONOMY**—Easily installed without extensive—and expensive—plant alterations.
- **COMPLETE** electrical control.

NEW: - "CONSTANT PRESSURE" ROLLER HOPPER

Closer diameter control • Improved product density • Increased production • Labor saving

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diamonds to utilize their hardest surfaces for increased life of diamond tools.

★ ★ ★

Reprint #3 is titled "X-rays Play Key Role in American Smelting Research" and describes the problems being handled on asbestos, refractories and high-purity metals.

New Combination Rolling Mill

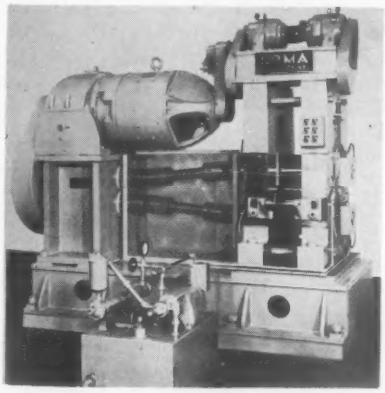
The development of a heavy-duty, high precision 2-high/4-high Combination Rolling Mill for application in metallurgical production and research work has been announced by **Loma Machine Manufacturing Co.**, 114 E. 32nd St., New York 16, N. Y. The new machine may be converted from a conventional vertical strip mill to a horizontal mill for compacting metal powders into sheet and strip up to ⅛" thick.

★ ★ ★

The machine is equipped with extra large capacity mill housings, roll journals, universal spindles and drive transmission. This allows the mill to take reductions of more than 50 per cent per pass while maintaining tolerances as close as 5 per cent of thickness.

★ ★ ★

Change-over from the 8-½ in. x 8 in. 2-high to the 2½ in. & 8½ in. x 8 in. 4-high setup requires only 30 minutes. The 2-high arrangement is used for either hot or cold breakdown rolling of plate and sheet, and grooved rolls are also available to process rounds, squares and other shapes. In the 4-high setup strip is cold finish rolled to gauges as thin as 0.002 in.



Loma Combination Rolling Mill

★ ★ ★

The mill is furnished with high-strength steel housings, twin-handwheel or dual-motor worm-drive screwdowns, universal joint spindles herringbone gearing, and an extra heavy-duty variable-speed drive. Roll necks are mounted in super-precision needle roller bearings having a total separating force capacity of 350,000 lgs.

★ ★ ★

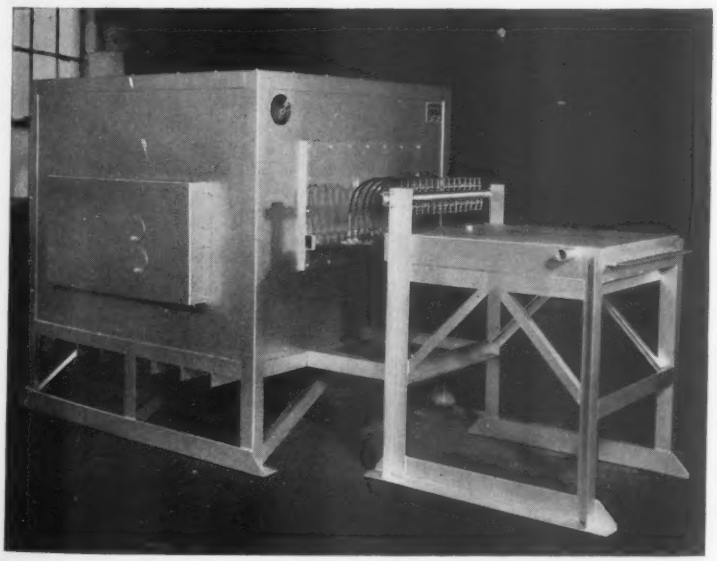
Full details may be secured from the manufacturer.

TO SELL—ADVERTISE IN
WIRE AND WIRE PRODUCTS

It pays—send for rates
453 Main St., Stamford, Conn.

HARPER STRAND ANNEALER

delivers bright stainless wire continuously at high speeds



Operating at temperatures from 2000°F. to 2200°F., this 30 tube Harper Electric Strand Annealing Furnace turns out Type 304SS wire bright and clean. Sizes from .02" to .0014" are passed through its 40" hot zone at rates up to 100 FPM per tube.

Providing close temperature control, Harper Strand Annealers maintain extremely dry reducing atmospheres to produce a truly bright finish. Designed for dependable, trouble-free performance over long periods, they permit wire speeds up to 150 FPM per tube.

Harper manufactures a full line of automatic conveyor, continuous tube, and bell type annealing furnaces for billets, bars, rods and wire. To solve your wire problem most profitably, call in a Harper engineer or write: Harper Electric Furnace Corporation, 42 River St., Buffalo 2, N.Y

HARPER
ELECTRIC FURNACES

AMERICAN IRON AND STEEL INSTITUTE
150 EAST FORTY-SECOND STREET, NEW YORK 17, N. Y.

AIS 10

MARCH - 1959
Month

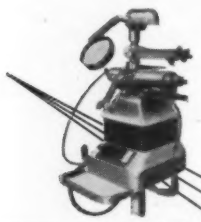
SHIPMENTS OF STEEL PRODUCTS
ALL GRADES INCLUDING CARBON, ALLOY AND STAINLESS
(Net Tons)

Covering Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or for Resale)

Steel Products	Items	Current Month 1959 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1958) Percent of Total Shipments	Year to Date * 1959 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1958) Percent of Total Shipments
Ingots and Steel Castings	1A	15,016	13,056	2,224	30,296	0.4	0.5	35,452	32,022	5,295	72,769	0.3	0.5
Blooms, slabs, billets, sheet bars	1B	116,634	52,609	1,364	170,607	2.1	2.4	293,561	132,660	4,164	430,385	2.1	2.3
Tube rounds	1C	970	242	1	1,213	-	-	3,629	944	4	4,577	-	-
Skelp	2	1,378	-	-	1,378	-	0.2	12,409	-	-	12,409	0.1	0.1
Wire rods	3	135,300	4,151	939	140,390	1.7	1.5	330,417	8,687	2,529	341,633	1.6	1.4
TOTAL SEMI-FINISHED		269,298	70,058	4,528	343,884	4.2	4.6	675,468	174,313	11,992	861,773	4.1	4.3
Bars—Hot rolled (incl. light shapes)	14	645,074	175,979	4,297	825,350	10.1	9.0	1,627,470	466,430	10,981	2,104,881	10.1	9.0
Bars—Reinforcing	15	216,829	-	-	216,829	2.7	3.2	500,500	-	-	500,500	2.4	2.6
Bars—Cold finished	16	129,363	23,930	5,980	159,273	2.0	1.8	333,943	66,061	14,771	414,775	2.0	1.8
Tool steel	17	1,146	8,438	-	9,584	0.1	0.1	2,752	22,026	-	24,778	0.1	0.1
TOTAL BARS AND TOOL STEEL		992,412	208,347	10,277	1,211,036	14.9	14.1	2,464,665	554,517	25,752	3,044,934	14.6	13.5
Wire—Drawn	23	278,295	4,285	3,347	285,927	3.5	4.0	705,730	11,397	7,989	725,116	3.5	3.7
Wire—Nails & staples	24	42,591	-	2	42,593	0.5	0.7	103,573	-	4	103,577	0.5	0.7
Wire—Barbed & twisted	25	6,911	-	-	6,911	0.1	0.2	15,605	-	-	15,605	0.1	0.1
Wire—Woven wire fence	26	20,655	-	-	20,655	0.3	0.4	45,662	-	-	45,662	0.2	0.3
Wire—Bale ties & baling wire	27	5,813	-	-	5,813	0.1	0.1	19,137	-	-	19,137	0.1	0.1
TOTAL WIRE & WIRE PRODUCTS		354,265	4,285	3,349	361,899	4.5	5.4	889,707	11,397	7,993	909,097	4.4	4.9
Sheets—Hot rolled	31	890,202	30,644	6,660	927,506	11.4	9.3	2,350,158	79,253	12,769	2,442,180	11.7	9.8
Sheets—Cold rolled	32	1,536,944	5,509	14,589	1,557,042	19.2	16.0	4,172,572	16,339	36,649	4,225,560	20.3	16.4
Sheets—Galvanized	33	311,961	-	-	311,961	3.8	4.4	872,842	-	-	872,842	4.2	3.9
Sheets—All other coated	34	30,336	-	-	30,336	0.4	0.3	82,788	-	-	82,788	0.4	0.3
Electrical sheets & strip	35	5,561	64,361	-	69,922	0.6	0.9	12,113	165,441	-	177,554	0.8	0.8
Strip—Hot rolled	36	149,584	2,836	1,903	154,323	1.9	1.6	376,675	6,737	4,319	387,731	1.9	1.6
Strip—Cold rolled	37	110,343	1,815	21,986	134,144	1.9	1.6	294,194	4,906	59,477	358,577	1.7	1.8
TOTAL SHEETS AND STRIP		3,034,931	105,165	45,138	3,185,234	39.2	34.1	8,161,342	272,676	113,214	8,547,232	41.0	34.6
TOTAL SHIPMENTS (1959)		7,534,355	515,408	67,925	8,117,688	100.0	xxx	19,333,342	1,330,050	172,510	20,835,902	100.0	xxx
TOTAL PRIOR YEAR (1958)		4,153,606	259,566	35,354	4,448,526	xxx	100.0	12,983,783	833,470	111,422	13,928,675	xxx	100.0

* Revised

42959



MODEL "S", for Steel: .01" - .08" diam. Copper: .01" - .072" diam.

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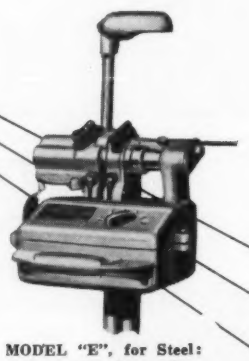
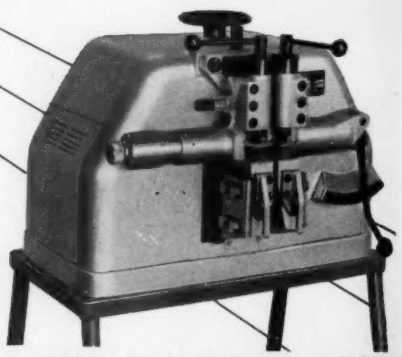
are universally used throughout the wire industry.

available with special control equipment to weld high carbon steel.



MODEL "E", for Steel: .04" - .32" diam. Copper: .04" - .25" diam.

Our range includes:
BUTT — SPOT — SEAM AND SPECIAL PURPOSE WELDERS



MODEL "M", for Steel: .16" - .51" diam. Copper: .16" - .37" diam.

You are cordially invited to submit inquiries

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PAUL REICHER MACHINERY & EQUIPMENT
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ALUMINUM INGOT AND MILL PRODUCTS AND MAGNESIUM MILL PRODUCTS: MARCH 1959

(Shipments and receipts are in thousands of pounds)

Item	Number of companies reporting shipments	March 1959			February 1959* net shipments	March 1958 net shipments
		Gross[1] shipments	Receipts[2]	Net[3] shipments		
ALUMINUM PIG AND INGOT, TOTAL[4]	90	234,873	117,831	117,042	99,853	59,895
ALUMINUM MILL PRODUCTS, TOTAL	152	295,286	22,364	272,922	231,760	187,023
Sheet and plate, non-heat-treatable	31	125,824	18,183	107,641	83,824	66,695
Sheet and plate, heat-treatable	4	22,180	...	22,180	21,176	15,245
Foil, including foil in lamination	13	(D)	(D)	20,938	17,747	15,483
Rolled and continuous cast, rod and bar[5]	6	13,592	3,012	10,580	9,108	5,254
Wire, bare, conductor and nonconductor	16	5,167	357	4,810	4,322	3,141
ACSR and aluminum cable, bare	11	(D)	(D)	13,168	13,683	13,831
Wire and cable, insulated or covered	14	4,003	...	4,003	3,725	3,286
Extruded shapes, alloys other than 2000 and 7000 series[6]	97	67,127	723	66,404	58,666	46,522
Extruded shapes, alloys in 2000 and 7000 series[6]	7	4,359	...	4,359	3,874	3,871
Drawn tube, alloys other than 2000 and 7000 series	12	(D)	(D)	7,810	6,083	5,737
Drawn tube, alloys in 2000 and 7000 series						
Welded tube, non-heat-treatable	7	4,037	...	4,037	3,499	[7]1,921
Powder and paste:						
Atomized	3	973	...	973	721	484
Flaked	5	344	...	344	375	249
Paste	5	1,262	...	1,262	962	804
Forgings (including impact extrusions)	15	4,413	...	4,413	4,003	4,500
MAGNESIUM MILL PRODUCTS, TOTAL	10	(D)	(D)	1,717	1,691	1,398

*Revised.

Sjogren RE-SPOOLER
This machine is especially designed for re-spooling wire on 2½ and 5 pound coils for both round and flat wire. Other models of similar design but of heavier capacity are available. Features include:
• SPEED: — Variable up to 1100 fpm for the 2½ pound spool, and 700 fpm for the 5 pound spool.
• TRAVERSE: — Spool is hydraulically traversed and is infinitely adjustable from zero to 3/8" per rpm of spool.
• CAPSTAN DRIVE: — Capstan for linear fpm also measures footage on predetermined counter and automatically shuts off machine at desired length.
• COILING BLOCKS: — Coiling blocks are interchangeable, to reduce downtime.
• TENSION: — Louis-Allis eddy current clutch type motor with potentiometer for variable tension. Also incorporated is forced acceleration and brake for quick stopping.
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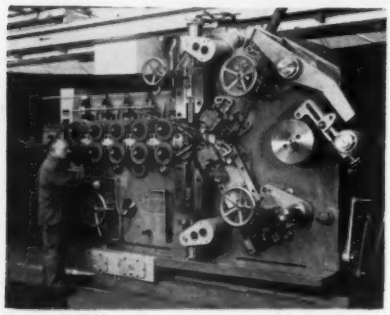
Announces New Spring Coiler

Wafios Machinery Corp., 61 Hudson St., Hackensack, N. J., has announced the availability of a new universal spring coiling machine, Model UFM/160, made by Wafios Maschinenfabrik in Reutlingen, Germany.

★ ★ ★

This machine, which is illustrated, will form cold or oil-tempered wire into springs, handling stock up to 5/8" in diameter.



Model U.F.M./160

★ ★ ★

Full details on this new machine are available from the American representative at the address above.

Anaconda Buys West Coast Cable Firm

Anaconda Wire and Cable Company has entered into an agreement to purchase 100% of the stock of **Sequoia Wire and Cable Company,** Redwood City, Calif., from Mandrel Industries, Inc. It will operate the company as a wholly-owned subsidiary.

★ ★ ★

Mandrel Industries will continue as a manufacturer of electronic instruments and custom assemblies at its Burbank, Calif., plant.

★ ★ ★

The purchase of Sequoia enables Anaconda to add missile and electronic control insulated wires and cables to its complete line of other wire and cable products and accessories. Sequoia presently employs approximately 150 persons at its Redwood City plant and offices.

"Cary Chem-Stracts"

The March issue of this bulletin, published by **Cary Chemicals, Inc.,** East Brunswick, N. J., contains an interesting article on house wiring —what the modern home needs to be protected against the hazards of inadequate wiring.

★ ★ ★

The bulletin also contains a list of the Cary products: its PVC compounds of low, medium and high molecular density; its waxes, and other materials relating to insulation. Descriptions and applications of each are given. Copies are available upon request.

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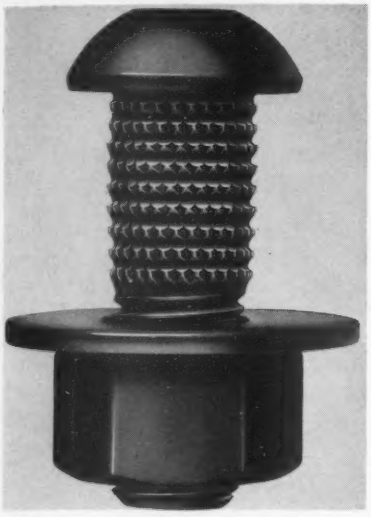
P2035

Announces New High Strength Structural Bolt

A high strength structural bolt combining the desirable features of both the Dardelet and high strength bolt has been announced by **The Lamson & Sessions Co.,** Cleveland, Ohio.

★ ★ ★

The new bolts have the tensile strength of a hex head high strength bolt with the bearing of a rivet, and are said to have the



highest shear strength and greatest resistance to slip of all structural bolts.

★ ★ ★

The bolts have a shank with specially formed knurls, set on a spiral to the driving load. Length of the knurled body is determined by thickness of the members to be joined. When the bolt is driven or pulled into place, the knurls produce a body-bound fit.

★ ★ ★

No head washers are necessary. Button head shape of the bolt head provides equivalent bearing area of a comparable hex head high strength bolt, plus a washer.

★ ★ ★

Three design features make these bolts easy to drive or pull into position: (1) frontal shape of each knurl is a section of a small ball; (2) back face is relieved somewhat like a drill or tap to prevent packing of displaced material; (3) knurls are set on a spiral to reduce driving force.

★ ★ ★

The bolts, made of heat-treated high carbon steel meeting ASTM A 325 specifications, can be used wherever conventional high strength bolts are used.

★ ★ ★

An engineering bulletin on these knurl-shanked high strength structural bolts may be obtained from The Lamson & Sessions Co., 5000 Tiedeman Road, Cleveland 9, Ohio.

New Spring Plant Opened in Atlanta

The Newcomb Spring Corporation, Southington, Conn., has announced the opening of a spring manufacturing plant in Atlanta, Ga.

★ ★ ★

Charles R. Porter, formerly Sales Manager of the Connecticut firm, has been made General Manager of the new plant. He has been succeeded at Southington by **William Histon.**

Far greater production in less space with lower cost equipment . . . for all steel and non-ferrous wire.
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The Process of Chemically Thermosetting Polyetheline

(*Continued from page 840*)

Table IV

	A-2	A-4	A-5
	P.E.-Black Together Mixed 10'	P.E. Fluxed 5' Black Mixed 5' Total 10'	P.E. Fluxed 3' 1/2 Black Mixed 5' Bal. Black Mixed 2' Total 10'
Addition of Peroxide	3 Min.	3 Min.	3 Min.
Total Time	13 Min.	13 Min.	13 Min.
D.C. Resistivity, 500 V, 70°C., Ohm-Cm.	5.8×10^{13}	3.2×10^{13}	2.2×10^{13}
Dielectric Constant, 1000 cps.	11.1	11.9	14.3
% Power Factor, 1000 cps.	4.5	4.5	6.8
Dielectric Strength, V/Mil.	97	91	83
Modulus @ 100% Elongation, p.s.i.	2020	2130	2150
Tensile Strength, p.s.i.	2440	2360	2430
Elongation, %	180	160	170

Table V

	A-2	B-2	C-2
Batch Volume, cc.	1000	900	1100
Polyethylene, Low Density	600 gm.	540 gm.	660 gm.
THERMAX®	600 gm.	540 gm.	660 gm.
Peroxide ****	12 gm.	10.8 gm.	13.2 gm.
Polymerized Trimethyl Di Hydroquinoline	6.0 gm.	5.4 gm.	6.6 gm.
	1218 gm.	1096.2 gm.	1339.8 gm.
D.C. Resistivity, 500 V, 70°C., Ohm-Cm.	5.8×10^{13}	5.8×10^{13}	8.3×10^{13}
Dielectric Constant, 1000 cps.	11.1	8.0	8.2
% Power Factor, 1000 cps.	4.5	3.5	3.3
Dielectric Strength, V/Mil.	97	169	115
Modulus @ 100% Elongation, p.s.i.	2020	2000	2050
Tensile Strength, p.s.i.	2440	2440	2400
Elongation, %	180	200	180

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and 13-minute total mix times were used, and again temperatures were controlled not to exceed 260°F.

★ ★ ★

Compounds B-2 and C-2 are 10% smaller and 10% larger, respectively, than the control stock. Both appear to be considerably superior to the control in degree of dispersion as judged by dielectric constant and per cent power factor. This indicates that in our laboratory Banbury, more studies are needed to establish the optimum loading for this material. It also carries the implication that any industrial internal mixer needs to be evaluated to determine its optimum batch size of thermosetting polyethylene compound, and that the more accurately this is done, the better will be the dispersion of black and the resultant electrical properties.

Summary

The important factors involved in the industrial processing of thermosetting polyethylene cable insulation compounds have been discussed. The most important of these considerations are temperature instrumentation and control since, as presently formulated, these compounds must be mixed and formed within a relatively narrow temperature range prior to curing.

★ ★ ★

Mixing procedure is also discussed, and measurements of dielectric constant and/or per cent power factor are recommended as suitable control tests for determination of effectiveness of dispersion of black fillers in polyethylene.

Acknowledgment

The author wishes to thank Messrs. **W. F. Abbey, B. C. Carlson, J. L. Tronson,** and **R. T. Zimmerman** of the **R. T. Vanderbilt Company** for their assistance in the preparation of this paper.

Note: The reader's attention is directed to Patent No. 2,888,-424, issued May 26, 1959, assigned to General Electric, which is directed to the curing of polyethylene using certain defined fillers and peroxides.

Continuous Annealing Preheating and Insulating of Electrical Conductors

(*Continued from page 847*)

annealer may stretch the wire beyond the second contact sheave, not because of tension but because of repeated bending and straightening in passing over sheaves and rollers.

★ ★ ★

In the beginning of this paper wire speed limitations were mentioned and we will now consider some of the factors which are involved. If 60 cycle alternating current is used, the wire speed must be low enough to provide an adequate number of current alternations to heat the wire. Conductor running at a speed of 2500 feet per minute will remain .12 seconds in a 5 foot length between contact sheaves 1 and 2 and be subjected to 7.2 current alternations. Four of the 5 foot lengths of wire may have 14 current impacts and one length may have 15 impacts, possibly resulting in a 150°F. higher wire heat. Any inclusion in the 5 foot section of wire undoubtedly would burn out. We think that at wire speeds above 2800 feet per minute, 60 cycle current does not provide a sufficient number of alternations to produce a uniform anneal. A higher frequency current or a longer annealing section may be the answer to this problem.

★ ★ ★

Despite this possible top limit of the wire speed, the annealer as it is used today has a built-in feature, referred to previously, which automatically provides some heat regulation. If, after the line is in operation and the elongation of the conductor has reached the desired value, the wire speed is increased, then the wire in the annealing section will run cooler and the resistance of the wire will decrease, allowing more current to flow in the wire at the fixed voltage, the current increase being proportional to the resistance reduction, the wattage will increase as the current and more heat will enter the wire. The ratio of watts per minute to feet processed per minute is constant despite wire speed fluctuations.

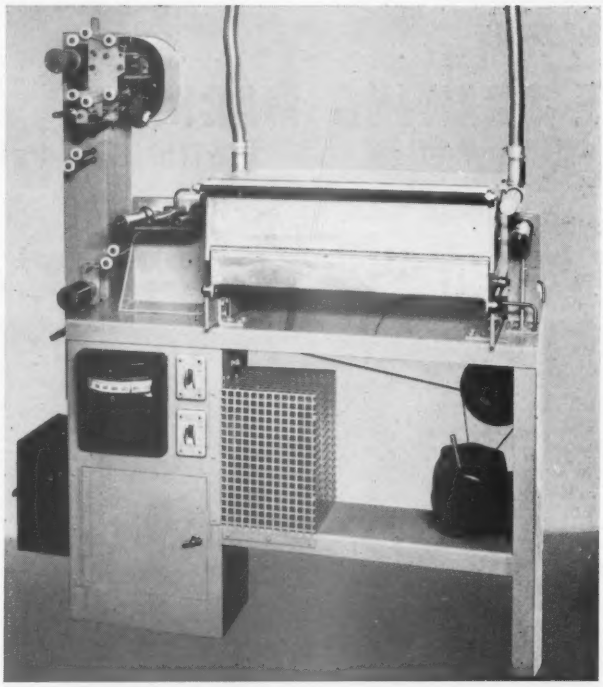
★ ★ ★

Finally, I would like to discuss some design considerations, not as criticism of any existing equipment, and I am aware that there are commercial machines in operation today which have many desirable design features.

1. **Exclusive of the contact sheaves in an annealer, sheaves that carry bare wire are subject to wear.**

HORIZONTAL FINE WIRE ENAMELING MACHINE

1247



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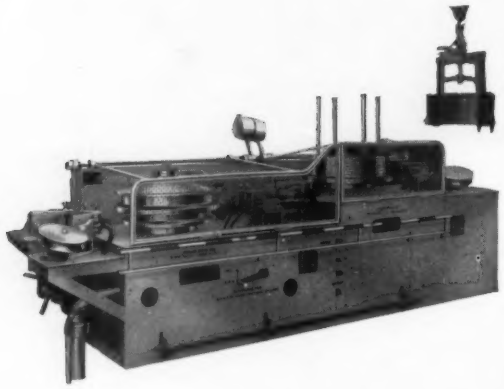
They are also subject to deterioration by arcing due to stray current flow to ground. Consider wire in contact with half of the sheaves through a 180° contact angle. If the sheave is solid and fabricated from a conducting material, the current flow is from the point the wire enters the groove directly to the point where the wire leaves the groove and arcing will occur at these two points. If moisture is present on the wire, burn marks will be evident on both the wire and in the bottom of the sheave groove. If possible, in sheaves where there is a likelihood of any current flow to the ground, a non-conducting material should be used. Unfortunately, these materials wear rapidly so that a suggested design is a grooved conducting rim attached to an insulated hub.

2. The description of an ideal contact sheave would be a narrow conducting bronze grooved rim attached to an insulated hub (no spokes) and with the rim electrically connected to an axially mounted slip ring. It would be ideal to have the rim act as the slip ring too but this would involve non-commercial elements. The idea of this design is to eliminate current concentration to points on the rim. Grooves in all sheaves should have steep sides and flat bottoms to reduce wire vibration. All sheaves in the annealer should be dynamically balanced and lined up so that the wire path is straight.
3. The annealer, if used in a tandem line should have interlock connections to other units but have as few controls as possible. The ammeter should be connected to the annealing leg of the transformer to indicate current flow in this section only.
4. Failure of current to enter the wire in the annealing leg or failure of the steam or water supply should activate visible or audible warning signals and not shut down the line.
5. The annealer should be built of corrosion resistant material and certainly a catch trough should be provided near the base of the machine to drain away water from leaks in the cabinet and the pipe fittings and an accessible sludge clean out sump should be built into the base.

The *Rehnqvist*

WIRE DRAWING MACHINE

with Back-Pull



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Do's and Don'ts in Handling Reels

Do's and don'ts to help safeguard the handling of reels of wire and cable are graphically illustrated on posters produced by the Packaging Committee of the Wire and Cable Section, **National Electrical Manufacturers Association.** Committee Chairman is **K. C. Crain,** National Electrical Div., H. K. Porter Co.

★ ★ ★

Direct credit for preparing the material, an improved version of similiar posters issued last year, goes to the Committee's new Materials Handling Subcommittee, which undertook the job as its first activity in the Section's long range program to reduce damage done to wire and cable in shipment or storage.

★ ★ ★

The illustrated posters which are particularly suitable for use around plants and shipping docks, for inclusion with shipments of wire and cable and for distribution to both carriers and customers. They come in two sizes—8½x11 inches and 12¼x17 inches, the latter printed on cardboard stock. The smaller poster sells for 15 cents per copy, and the larger poster for 25 cents each. Bulk rates available for quantity orders. They may be ordered from Wire and Cable Section, National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y.

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(*Continued from page* 833)

trol features built into this specialized equipment which would require a lengthy explanation beyond the scope of this general subject.

★ ★ ★

In summary, there are a great many alternates to choose from in the selection of each component which goes to make up a complete insulating package. Each of these components was obviously conceived and built to perform some specific function more effectively than some similar item which is alternately available.

★ ★ ★

For this reason it is so important to first decide what the bulk of the work load will be on this particular machine, and select accordingly. An analogy to emphasize this point might be the case of a farmer selecting a motor vehicle for use on the farm. A tractor would be excellent for pulling heavy loads at slow speeds, but he would never think of using it to take his family out for a Sunday afternoon drive! A ten ton truck would have another specific use where it would excel, but again he would not expect it to cruise comfortably or economically down a highway at sixty miles an hour. He might compromise on a pickup truck, but it would have nowhere near the capacity of the heavy truck nor would it be as roomy or as attractive as a family car. His best solution would obviously be to have two or three types of vehicle; each to be used only for what it was designed. So it would also be with any wire handling system.

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The Wire Man's Magazine

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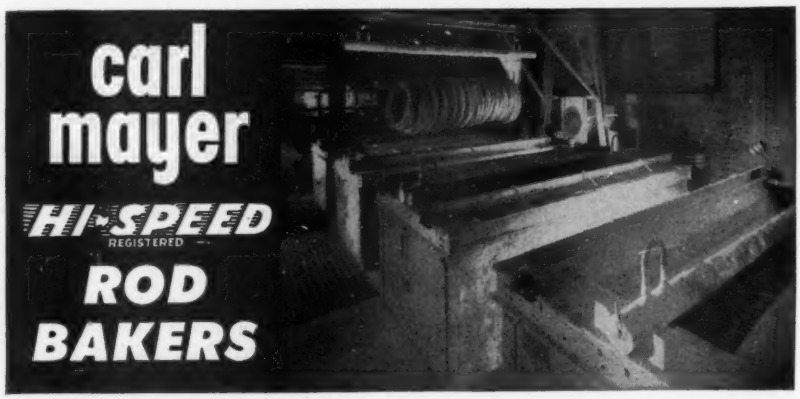

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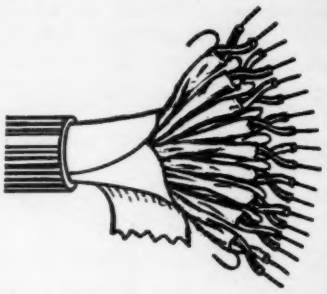
Belden Announces New Cables

Belden Manufacturing Company, Chicago 80, Ill., has introduced a number of new cables.

★ ★ ★

One is a multiconductor, individually paired and shielded intercom cable supplied with either 9 or 15 pairs of #22 AWG wires, Belden 8264.



Another is Belden 8283, the only complete cable for color TV made. It contains 82 conductors shielded with Beldfoil aluminum — Mylar shield. It contains 8 coaxial cables.

A third is a new Sterco Remote Volume Control cable specifically designed for coin-operated phonographs. This cable contains 10 flexible stranded conductors, some groups of which are shielded to prevent interference.

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New Fenn Copper Flat Wire Mill

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★ ★ ★

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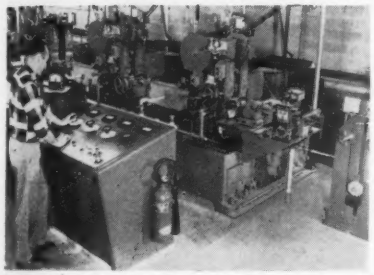

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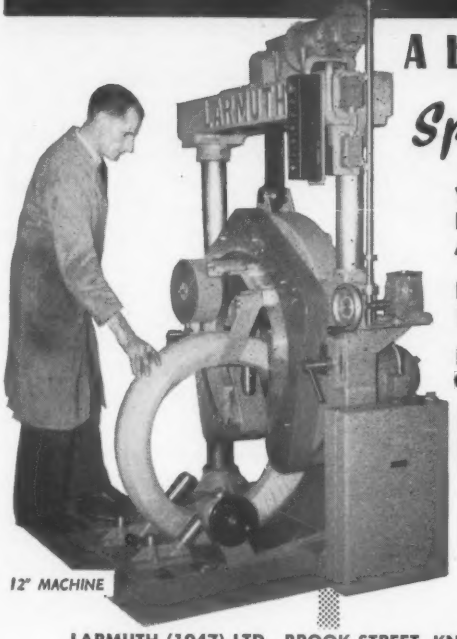

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Regional Meeting of the Electric Wire and Cable Section

(*Continued from page* 854)

Life", which resulted in a deluge of appreciative letters, one even from a gentleman in Denver with 20-20 vision, offering to give him an eye, provided it could be grafted. Interestingly enough, the Judge turned down this unusual and generous offer, feeling that having adjusted himself over so many years to his state, the restoration of sight for him was no longer a necessity. He had lost his sight as the result of damage to his eyes by a piece of wire when he was nineteen, had gone to college, studied law, and risen steadily from its practice to his present position.

The Plant Inspection Trip

On Thursday afternoon, buses left the hotel at 1:00 o'clock for Cambridge to go through the plant of the **Simplex Wire and Cable Company.** 235 persons took the tour.

★ ★ ★

The business started 113 years ago as a wire working shop. In 1885, under the name Morss and White Company, it manufactured its first length of insulated wire and in the intervening years has risen to a position of preeminence in the wire and cable industry. In 1913 it adopted its present name and presently the plant occupies approximately 20 acres of floor space.

★ ★ ★

The company draws most of its own wire from rod and performs all of the other operations required for turning out a large variety of electric wires and cables. Its guests, conducted about the plant in small groups by competent guides, were able to see all of the operations from tinning and stranding through rubber and plastic blending, extruding, lead sheathing, and so forth. Laboratories were visited, where research, quality control, and testing procedures were followed with meticulous care.

★ ★ ★

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The Standard of the Wire Industry

Mr. Everett Morss, President of this large and progressive company, for the many courtesies shown them on this occasion, which was most rewarding.

The Program Committee

Responsible for the very patent success of this first Regional Meeting of the Electric Wire and Cable Section was an able committee. These men were:

General Program Chairman
Urbain J. H. Malo, Mgr., Product Engineering
Carol Cable Co., Div. of
The Crescent Co., Pawtucket, R. I.

Local Arrangements
Alfred Garshick, Devel. Engineer
Boston Insulated Wire Co.
Boston, Mass.

Plant Visitation
George H. Hunt, Res. & Devel. Mgr.
Simplex Wire & Cable Co.
Cambridge, Mass.

Ladies Program
Joseph P. Wildgoose, Devel. Engineer
Collyer Wire & Cable Co.
Pawtucket, R. I.

Social Program
Roger T. Stafford, Proj. Engineer
Kennicott Wire & Cable Co.,
Div. of The Okonite Co.
Phillipsdale, R. I.

★ ★ ★

That these gentlemen left no stone unturned to assure a smooth working meeting was most evident at its close. The program's satisfactory functioning might well serve future program committees as a pattern for further regional meetings of the Section.

★ ★ ★

The officers and directors of The Wire Association are grateful to each member of the committee for a job exceedingly well done. They have earned the plaudits, not only of the Association's officials, but of all those who had the good fortune to attend the two-day session.

★ ★ ★

It might be added that when the Electric Wire and Cable Committee appointed Mr. Malo to be the guiding spirit of this meeting, they chose well—he produced a program of events that exceeded their expectations.

★ ★ ★

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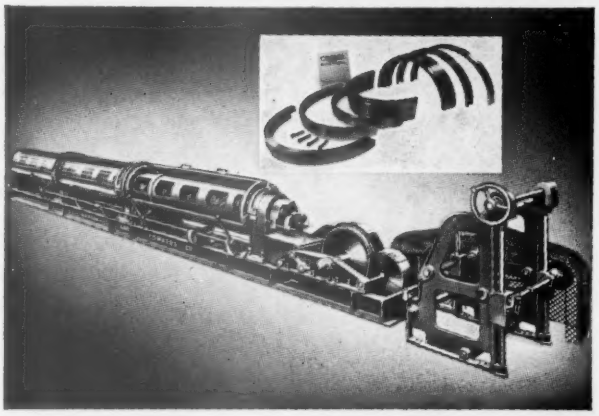

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Among registrants, it is interesting to note that people had come to the meeting from all parts of this country, an excellent representation had journeyed to Boston from various provinces of Canada, one man came from England, and one from the other side of the world, Mr. **David G. Hamilton,** Technical Director of **H. C. Urlwin Ltd.** in Christchurch, New Zealand, manufacturers of electric wire and cable there.

The Wire Association Awards for 1958

(*Continued from page* 855)

lection of a resort hotel. It was decided that information on such hotel is to be secured by the Executive Committee Secretary before the next meeting of the Board in October.

★ ★ ★

Mr. Lawson stated that Mr. Malo had done an outstanding job in organizing the Electric Wire and Cable Section's meeting in Boston and that he had been successful in one innovation, the solicitation of funds from suppliers to finance the Hospitality Hour.

★ ★ ★

Following a discussion as to possible sources for a few final papers for the ferrous program, a motion was made to ratify the acts of the officers and directors for the period covered by the Secretary-Treasurer's report, which was duly seconded and carried. The meeting was then formally adjourned at 11:30 o'clock.

Wire Kinks

(*Continued from page* 859)

pounds per square foot for the bars to 3.8 pounds for the fabric, yet the fabric design allowed for steel stresses of 24,000 psi, against 20,000 psi for the bars.

★ ★ ★

A floor was completed every 2 or 3 days and a total of three weeks was saved on the flat plate-wire fabric reinforced design.

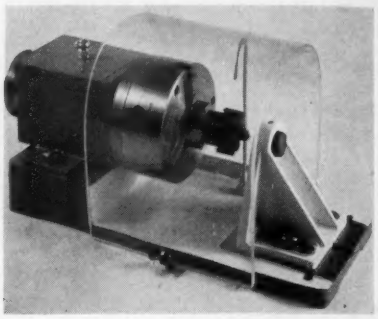
—Courtesy of Wire Reinforcement Institute, Inc.

New Machine Developed to Clean Wire and Rod

Beard Machine Company has designed and is now producing a machine that will clean dirt, rust, and light scale from rod and wire ranging in size from 3/8" to 1/32" in diameter.

★ ★ ★

The machine measures 6½" wide x 12" long x 7" high and weighs about 38 pounds. Its compact size



allows it to be mounted on existing equipment.

★ ★ ★

Bearings are sealed against dirt, an air stream keeps the wire brushes clean, and changes from one wire size to another can be made in a matter of minutes.

★ ★ ★

For full details, write the company at Dept. W, 209 Butter St., York, Pa.

Rubber Plant Expands to Produce Polyethylene

The Imperial Rubber Manufacturing Co., Hackettstown, N. J., has opened a new plant for the custom compounding of cross-linked polyethylene for cable jacketing.

★ ★ ★

The business, headed by James Cooke, President, now has a daily capacity of 25,000 pounds of this insulating material and has, in addition, a similar daily capacity for the production of neoprene compounds. The company is also a manufacturer of carbon black dispersions for polyethylene.

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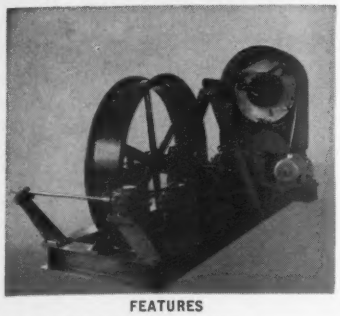

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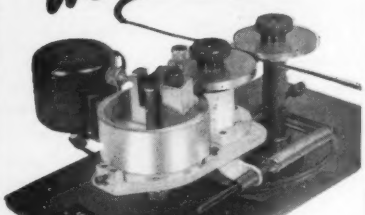

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Induction Heating System for Thermoplastic Extrusion

(*Continued from page 836*)

the number of turns required increases with the primary operating voltage whereas the primary current decreases at the same ratio. The choice of a proper primary voltage is a question of balancing the pros and cons of coils with a high number of turns and small wire versus low number of turns and heavy wire. For an extruder, sizes in the range of 2 to 8", 240 volts, seem to be a very practical choice.

★ ★ ★

As far as the losses are concerned, they are mostly resistance losses in the primary coil which can be held at a low level by proper dimensioning. In this respect, it is important to take into account that the current distribution in the primary coil shows a pattern similar to the distribution in the cylinder wall which we have depicted in Figure 6.

★ ★ ★

Regarding the power factor, we have measured values of .80 in operation. If the unit is properly designed, the power factor will automatically be satisfactory. However, it is always possible to improve it by the addition of capacitors.

★ ★ ★

In order to be able to control the temperature of the wall satisfactorily, the induction heating system has to be augmented by an adequate cooling system. At the cost of a slight increase in the magnetic reluctance of the system, we can separate the coils from the outer surface of the cylinder to provide space for the flow of a cooling medium. In doing so, we have to make sure that the supports of the coil are properly separated in order to avoid undesired secondary currents, especially in a case of air cooling when they should be of a material with high thermal conductivity.

★ ★ ★

Normally the heating and cooling requirements in the various zones of an extruder differ, and it is therefore necessary to sub-divide

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the entire heating unit into a number of sections with independent heating and cooling units. As far as the temperature control is concerned, a thermocouple inserted into the wall in each section acts as a feed back indicating the deviation from any set temperature level. Due to the good response of induction heating, a simple On-Off control is satisfactory. This control simply turns the heat on if the temperature drops below a certain tolerated level, and turns it off if the temperature exceeds the set temperature for the same small amount. The same thing applies to the cooling system.

★ ★ ★

The induction heating unit which is built directly around the extruder cylinder with the cooling system, which is arranged co-axially under the primary coils, can be fitted very compactly onto the extruder. If the electric controls are also incorporated into the design of the extruder, the result

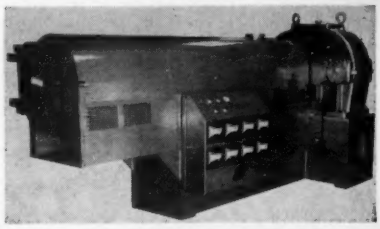

Fig. 7—Farrel Inductomatic Extruder—Model D-350. This 3½" extruder has 20:1 length-to-diameter ratio, 4 cylinder heat zones and 1 head-gate heat-control zone, and 3 additional die-heat control zones, which are optional. Operates on 240 or 480 volts and has a max. demand on the cylinder of 27 watts. Heat-up time to 400°F is 27 mins. Requires a 40HP drive and will operate at a max. screw speed of 100 RPM. weight: 4800 lbs.

is a well-proportioned, functional looking design. Figure 7.

★ ★ ★

In summary, the advantages of the Inductomatic Extruder are the long life expectancy of the heating elements, the ability to provide space for an efficient cooling system separated to a high degree from hot heating elements, and the ability to generate heat within the cylinder wall, rather than by surface contact, thus reducing to a minimum the amount of overshoot when approaching a temperature setting.

The Controlled Cooling of Extruded Polyethylene Insulations

(Continued from page 842)

This was done in spite of the fact that everyone knew the shrinkage characteristics of polyethylene were such that rapid cooling resulted in the formation of voids. It was rationalized or temporized on the part of some people that this did not happen in thin walls . . . but all of the evidence indicates that it does. If you carefully examine Figure 2, showing a 15 mil wall over a #20 solid conductor

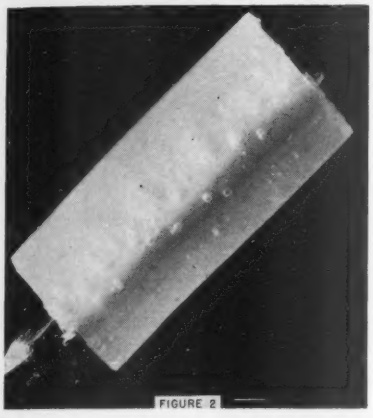

FIGURE 2

which was shocked cooled in ice water, it can easily be seen under magnification that there are voids.

★ ★ ★

Therefore, and this is the point that we want to leave with you, in thin walls, controlled cooling is not one of those things that you can take or leave—it is just as important in thin walls as it is in heavy walls.

★ ★ ★

It might again be conjectured that a 10 mil wall on a #24 conductor is in an area where controlled cooling is no longer necessary. However, this kind of thinking can be carried to an extreme. The shrinkage, crystalline and amorphous characteristics of polyethylene are not respectors of thin walls or our rationalization with respect to these properties. If optimum results are to be accomplished and if polyethylene with the best electrical and physical properties is to be obtained, then the cooling of extruded polyethylene must be controlled.

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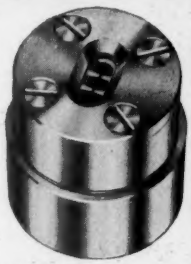

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Common Extrusion Problems and Their Solution

(*Continued from page* 828)

feet is $0.167. Since fixed cost levels will vary from plant to plant, a series of curves shown in Figure 9 have been computed which relate

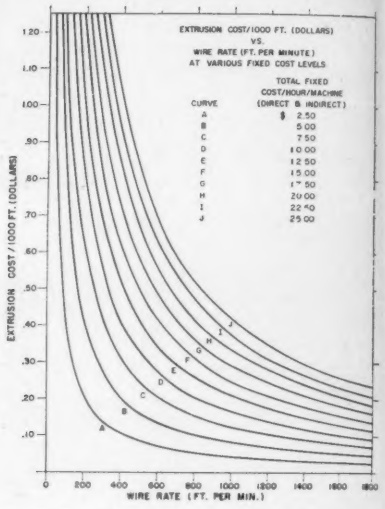

Fig. 9

cost per 1000 feet with wire rate in feet per minute for any type construction. These curves show the increase of cost by reduction in rate or conversely the decrease in cost per 1000 feet at higher rates.

★ ★ ★

Table III shows some cost figures taken from the chart. It is noticed that at higher extrusion speeds, changes in rate have less effect on extrusion cost per 1000 feet than at lower rates.

Conclusion

In this article some problems encountered in the extrusion of vinyl insulation and jacket have been presented in detail. Using as a background recent theoretical work done on the extrusion operation, suggested corrective actions to clear up these problems have been summarized. Production departments must have a maximum volume of quality product from a given piece of equipment at minimum cost, and a means has been suggested for determining the increase in extrusion cost per 1000 feet of wire caused by lower take-up rates which may result from

corrective actions. A comparison of the additional extrusion costs per 1000 feet with the cost of equipment replacement or redesign costs (amortized over a given volume of production) will provide the information needed to ascertain the most economical means of attaining production goals.

Quality Control In The Manufacture of Submarine Cable

(*Continued from page* 851)

ating process, where the diameter of the tape-stranded central conductor is monitored continuously by a mechanical gauge which transmits an electrical signal to a recorder.

* * *

The diameter requirements for this conductor are very strict. Whenever the diameter chart indicates that the diameter of the conductor varies from the nominal by as much as .0003", the insulated conductor must be examined to try to find the reason for the deviation. If the diameter deviates by .0005" or more, the portion of insulated conductor containing the deviation must be scrapped, regardless of the cause.

* * *

Experience has shown that some of the indicated diameter deviations are actually bends in the center wire of the tape-stranded conductor. These bends are usually the result of trapped turns on the center-wire supply reel at stranding.

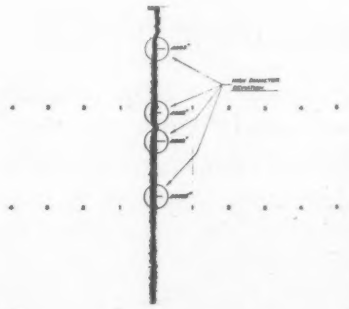

Fig. 5—Diameter chart showing high diameter deviations in Central Conductor at Insulating.

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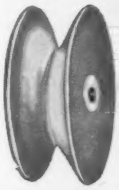

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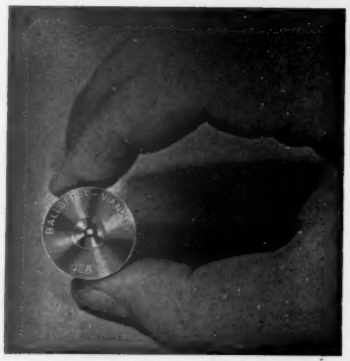

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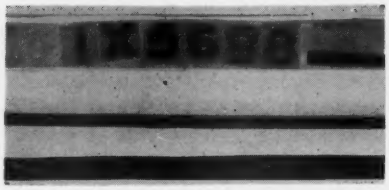

Fig. 6—X-Ray photograph of bend in Central Conductor found as a result of chart inspection (Figure 5).

All bends that are suspected of exceeding the allowable standard are X-rayed for comparison to the standard. Figure 5 is a diameter chart showing spikes resulting from trapped turns, and Figure 6 is an X-ray photograph of one of the bends.

* * *

Considerable work has been done with the supplier of center wire to improve their traverse techniques and thereby reduce the trapped turns problem. During the last year, core scrap, as a result of this and other studies, has been reduced by approximately 6 per cent.

* * *

As this type of insulated conductor must be joined together to form continuous lengths many miles long, any reduction in scrap is not only economical but an improvement in the quality as well, because the number of joints required is reduced.

Example 5:

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erly handled or packaged has been damaged, and subsequently caused production problems. There are perhaps as many examples as there are materials. In the case of the armor line described in Example 1, any breakage interferes with a machine cycle and therefore adversely affects the performance of the materials used on this line. Jute, either cutched or impregnated, is the most susceptible to breakage. Jute was formerly shipped in burlap bales which did little to prevent damage. A heavy weatherproof paper wrapping was later substituted. This protected the material but was inefficient in handling. Prolonged storage of the jute allowed the package to soften, causing instability of stacking. Several different cartons were tried before settling on that shown in Figure 7. The result has been a package which protects the material from contamination, eliminates instability in stacking, and minimizes the chances of physical damage. In addition to these gains the cost of the packaging was reduced by 50 per cent.

Example 6:

As a final example, let's explore

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Fig. 7—Palletized cartons used to package cops of jute. Note stacking arrangement. * * * *

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★ ★ ★

The Quality Control techniques described in this paper are aimed at solving the problems associated with the manufacture of submarine cable. The objectives and methods were developed with cable cost a prime consideration. While it might appear that this Quality Control Program is expensive, we have found, in fact, that it pays for itself. The key to its success is participation by the entire organization; and the result is "Better Quality at Lower Cost."

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Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Hyprez Div., Engis Equipment Co., Chicago, Ill
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Research Company, St. Clair Shores, Mich.
New England Wire Die Co., Worcester, Mass
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

DIAMOND POWDER RECLAIMING—
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Fort Wayne Diamond Products, Inc., Fort Wayne, Indiana.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Research Co., St. Clair Shores, Mich
Rusch Wire Die Corp., Croton-on-Hudson, N. Y

DIAMOND TOOLS—
Indiana Wire Die Co., Ft. Wayne, Ind.
Wayne Wire Die Co., Linden, N. J.

DIES—Carbide, Tungsten & Tantalum
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

DIES—Cold Heading
Eastern Carbide Corp., New Rochelle, N. Y
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France

DIES—Diamond
Ajax Industrial Supplies, Inc., Ft. Wayne, Ind
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Ft. Wayne Wire Die Inc., Fort Wayne, Ind
Hoosier Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., Inc., New York, N. Y
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y
Wayne Wire Die Co., Linden, N. J.

DIES DIAMOND—Drawing Angle Controlled
Hoosier Wire Die, Inc., Ft. Wayne, Ind.

DIES DIAMOND—Reversible
Indiana Wire Die Company, Fort Wayne, Indiana
National Wire Die Co., Inc., New York, N. Y.

DIES—Extrusion
Central Tool and Machine Co., Bridgeport, Conn.
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France
Rusch Wire Die Corp., Croton-on-Hudson, N. Y
Wayne Wire Die Co., Linden, N. J.

DIES—Eyelet
Eastern Carbide Corp., New Rochelle, N. Y
Kelloy Corporation, New York, N. Y.

DIES—Marking and Stamping
Jas. H. Matthews & Co., Pittsburgh, Pa.

DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.
Pittsburgh Carbide Die Co., Monongahela, Pa.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.

Eastern Carbide Corp., New Rochelle, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Linden, N. J.

DIES—Roll Threading
Rivom, Dijon, France

DIES—Special Shapes, Etc.
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Rivom, Dijon, France

DIES—Swaging
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

DIES—Tinning
Roux Wire Die Works, Inc., Oriskany, N. Y.

DIES—Tube Drawing
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Hoosier Wire Die., Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Rivom, Dijon, France
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Wire Packaging
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

DRUMS & TRAVERSES—For Cable Reels
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

DRYING EQUIPMENT—
Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A. Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FOAM PRODUCING COMPOUNDS—
Amchem Products, Inc., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

FURNACES—Brazing
Ajax Electric Company, Philadelphia, Pa.
Harper Electric Furnace Corporation, Buffalo, N. Y.
Sunbeam Equipment Corporation, Meadville, Pa.

FURNACES—Galvanizing Equipment
Sunbeam Equipment Corporation, Meadville, Pa.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Company, Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Harper Electric Furnace Corporation, Buffalo, N. Y.
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Sunbeam Equipment Corporation, Meadville, Pa.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Company, Philadelphia, Pa.
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Sunbeam Equipment Corporation, Meadville, Pa.

FURNACES—Resistance Heating, Strand
Harper Electric Furnace Corporation, Buffalo, N. Y.
Sunbeam Equipment Corporation, Meadville, Pa.

FURNACES—Salt Bath
Ajax Electric Company, Philadelphia, Pa.

FURNACES—Strand Annealing
Ajax Electric Company, Philadelphia, Pa.
Harper Electric Furnace Corporation, Buffalo, N. Y.
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Sunbeam Equipment Corporation, Meadville, Pa.

GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INKS—Printing, for Insulated Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

INSULATING MATERIALS —
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
Celanese Corporation of America, New York, N. Y.
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
General Tire & Rubber Company, The, Akron, Ohio
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Takemura & Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Bobbin Winders
Hanson & Edwards, Ltd., Warrington, England
Larmuth and Bulmer, Limited, Manchester, England

MACHINERY—Bolt, Rivet, Screw, etc.
Behr Machinery & Equipment Corp., Rockford, Ill.
Takemura & Co., Ltd., New York, N. Y.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Braiding
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Synero Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)

MACHINERY—Centerless Grinding & Polishing
American Laubscher Corporation, New York, N. Y.

MACHINERY—Chain Link Fence
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Steel & Wire Machinery Co., Cleveland, Ohio

MACHINERY—Chain Making
Larmuth and Bulmer, Limited, Manchester, England
Pan American Supply Company, New York, N. Y.
Steel & Wire Machinery Co., Cleveland, Ohio
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Closing Cable
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Cold Heading
Behr Machinery & Equipment Corp., Rockford, Ill.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn, Maschinenfabrik, Herborn, Germany
Morgardshammars Mek Verkstads A. B., Morgardshammar, Sweden
National Mach'y Exch (Used), New York
Showa Machine Works, Ltd., Osaka, Japan
Steel & Wire Machinery Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn
Pan American Supply Company, New York, N. Y.

MACHINERY—Dead Block (Stationary Coiler)
Morgan Construction Company, Worcester, Mass.
Wells Company, Frank L., Kenosha, Wisc.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Maschinenfabrik, Herborn, Germany
Pangborn Corporation, Hagerstown, Md.

MACHINERY—Diameter Control
Daystrom-Weston, Industrial Gauges, West Englewood, N. J.

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark N. J.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Wayne Wire Die Co., Linden, N. J.

MACHINERY—Draw Benches
General Machine Tool Co., Worcester, Mass.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Co., Wallingford, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Extruding
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Royle, John, & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Flat Wire
General Machine Tool Co., Worcester, Mass.
Mettler Machine Tool, Inc., New Haven, Conn
Stanat Manufacturing Co., Inc., Westbury, L. I., N. Y.
Steel Equipment Company, Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming Wire
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Galvanizing Wire
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Steel & Wire Machinery Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Insulation Testing (See MACHINERY—Spark Testing)

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia, Pa.
Cook Mfg. Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Michigan Oven Company, Detroit, Mich.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
EVG., Machinen & Stahl, A. G., Zurich, Switzerland

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY — Measuring Diam., Insulated Wire
Daystrom-Weston, Industrial Gauges, West Englewood, N. J.

MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wisc.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Packaging Wire
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Paper Clips
Pan American Supply Company, New York, N. Y.

MACHINERY—Patenting Wire
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Pin Making
Takemura & Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Plating
Bartell Machine Tool Corp., Rome, N. Y.
Hodge Bros. Machine Shop, Ossining, N. Y.
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Printing on Electric Wire
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

MACHINERY—Re-Spooling
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
General Machine Tool Co., Worcester, Mass.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
National Mach'y Exch. (Used), New York N. Y.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Ring Forming
Pan American Supply Company, New York, N. Y.

MACHINERY—Rod Mill
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Slitting Mills
Steel Equipment Company, Cleveland, Ohio

MACHINERY—Spark Testing
Davis Electric Co., Wallingford, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Peschel Electronics, Inc., Towners, N. Y.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Special
General Machine Tool Co., Worcester, Mass.

MACHINERY—Spooling Tension Controls
Web Controls Corp., West Englewood, N. J.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells Company, Frank L., Kenosha, Wisc.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY— Staple Making
Pan American Supply Company, New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Straightening & Cutting
American Laubscher Corporation, New York, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn
National Mach'y Exch. (Used), New York N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wells Company, Frank L., Kenosha, Wisc.

MACHINERY—Stranding
Bartell Machine Tool Corp., Rome, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth & Bulmer Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Düsseldorf-Rath, Germany
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Swaging
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Kraft, J. A., Maschinenfabrik, OLPE/Westf. Germany
Larmuth & Bulmer Limited, Manchester, England
Litzler, C. A., Co., Inc., Cleveland, Ohio
Northern Indiana Steel Supply Co., Inc., Michigan City, Indiana
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Wardwell Braiding Machine Co., Centra Falls, R. I.
Watson Machine Co., Paterson, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Kraft, J. A., Maschinenfabrik, OLPE/Westf. Germany
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine) France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Testing for Dielectric Faults
Peschel Electronics, Inc., Towners, N. Y.

MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Thread Rolling
Mettler Machine Tool, Inc., New Haven, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cook Manufacturing Co., The, Paterson, N. J
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)

Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

MACHINERY—Welded Wire Mesh
E. V. G., Maschinen and Stahl, A.G., Zurich, Switzerland
Schlatter, Ltd., H. A., Zollikon/Zurich

MACHINERY—Wire Weaving
Takemura & Co., Ltd., New York, N. Y.

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery—Welding Wire Fabrics)

MACHINERY—Winding Wire
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
General Machine Tool Co., Worcester, Mass.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Laubscher Corporation, New York 19, N. Y.
Atlas Polar Co., Ltd., Toronto, Ont., Canada
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Morgan Construction Co., Worcester, Mass.
Morgardshammars Mek Verkstads AB, Morgardshammar, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Showa Machine Works Ltd., Osaka, Japan
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Wire and Machinery Co., Cleveland, Ohio
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Takemura Co., Ltd., New York, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Wire Forming
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Takemura Co., Ltd., New York, N. Y.

MACHINERY—Wire Rope
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
American Laubscher Corp., New York, N. Y.
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Company, Boston, Mass.

MARKING & STAMPING DIES—(See DIES—Marking and Stamping)
Jas. H. Matthews & Co., Pittsburgh, Pa.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio

NAIL TOOLING—Tungsten Carbide
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Central Tool and Machine Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Michigan Oven Company, Detroit, Mich.

OVENS—Rod Bakers
Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

PAILS—Packaging
(See Drums—Wire Packaging)

PAINT BONDING CHEMICALS—
Amchem Products, Inc., Ambler, Pa.

PAINTS—Heat Resisting
Amchem Products, Inc., Ambler, Pa.

PAPER—Insulating
Twitchell, Inc., E. W., Philadelphia, Pa.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PLASTICIZERS—
Cary Chemicals, Inc., New Brunswick, N. J.
Celanese Corporation of America, New York, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

PLASTICS—for Wire Insulation
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
Celanese Corporation of America, New York, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation. New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

PRINTING WHEELS—for Electric Wire
Daniels & Co., Frank, New York, N. Y.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., Inc., West Hanover, Mass.
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

RACKS—Wire Storage
Jarke Manufacturing Co., Chicago, Illinois

REEL AND TENSION STANDS—
Mettler Machine Tool, Inc., New Haven, Conn.
Northern Indiana Steel Supply Co., Inc., Michigan City, Indiana
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

REELS—Metal Bound
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.

REELS—Plywood
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
New York Engineering Corp., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Steel, for Rope and Cable
New York Engineering Corp., Yonkers, N. Y.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Boonton Molding Company, Boonton, N. J.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Niederrheinische Huette, A. G., Duisburg, Germany
Pittsburgh Steel Co., Pittsburgh, Pa.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

ROLLS—For Flattening Wire
General Machine Tool Co., Worcester, Mass.

ROPE—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J

RUST PROOF COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

SATURATION SYSTEMS—
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket R. I.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—Plastic
Boonton Molding Company, Boonton, N. J.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.

Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

STOCK STORAGE SYSTEMS
Jarke Manufacturing Co., Chicago, Illinois

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J
Youngstown Sheet & Tube Co., Youngstown, O

TANKS—Ceramic, for Galvanizing
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TENSION METERS—for Wire
Boulin Instrument Corporation, Pelham, N. Y.

TESTERS—INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT
(See MACHINERY Testing, Physical and Diameter Testing)

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

TRANSMISSIONS—Variable speed (See Adjustable Speed Drives)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Hodge Bros. Machine Shop, Ossining, N. Y.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VARNISHES & LACQUERS—for Electric Wire
General Electric Company, Insulating Materials Section, Schenectady, N. Y.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

WAXES—for Insulated Wire
Cary Chemicals, Inc., New Brunswick, N. J.

WELDERS—Spot and Butt and Welding Wire Fabrics
Eisler Engineering Corp., Newark, N. J.
E. V. G., Maschinen and Stahl, A.G., Zurich, Switzerland
Micro Products Co., Chicago, Ill.
H. A. Schlatter, Ltd., Zollikon-Zurich

WHEELS—for Printing on Electric Wire
Daniels & Co., Frank, New York, N. Y.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M., Co., Inc., West Boylston, Mass.

WIRE—Aluminum
Malin & Co., The, Cleveland, Ohio
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Ball
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Malin & Co., The, Cleveland, Ohio
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Bunched and Stranded
Camden Wire Company, Camden, N. Y.

WIRE—Cadmium
Stamford Processing Co., Peekskill, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Copper
Camden Wire Company, Camden, N. Y.
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

WIRE—For Electrical Conductors
Camden Wire Company, Camden, N. Y.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Flat
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Montgomery Co., The, Windsor Locks, Conn.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—High Carbon
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Manufacturers
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corporation, Pressed Steel Div., Cleveland, Ohio
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Metalizing
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio

WIRE—Needle
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Alloy
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

WIRE—Oil Tempered
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Special Shapes
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
National Lock Washer Company, The, Newark N. J.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Spring
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's John A., Sons Corp., Trenton, N. J.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Malin & Co., The, Cleveland, Ohio
National Lock Washer Company, The, Newark, N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Steel—Also Coppered and Galvanized Steel
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting
American Chain & Cable, Page Steel Wire Div., Monessen, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

YARNS—Wire Insulating
Synthetic Thread Co., Bethlehem, Pa.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON 16, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE AND MASTICATING MACHINERY MANUFACTURERS

WATSON

VERTICAL BUNCHERS TYPE "V"

U. S. PATENT 2,773,344

THE LEADING DESIGNS WITH AN INTERNATIONAL REPUTATION

NOTABLE ADVANTAGES:

1.—HIGHEST LONG-RUN OUTPUT ON LARGE STANDARD WIRE REELS.
2.—GREATEST COMPACTNESS. IDEAL FOR ROW GROUPING IN LIMITED SPACE.
3.—LABOR-SAVING. ONE OPERATOR CAN SERVE MANY MACHINES.
4.—QUICKEST PARTS SERVICE FROM CATALOGUED STOCK.
5.—LOWEST MACHINE COST DUE TO QUANTITY MANUFACTURE.

SUITABLE FOR ALL COMMON BUNCHING WORK, AND USED ALSO FOR BUNCH-STRANDING AND CABLING OF STEEL AND ALUMINUM CLOTHESLINE, TELEVISION GUY WIRE, SEALING STRANDS, METAL FISH LINES, PAPER CORD, CONTINUOUS TWISTS OF FLAT WIRE, SMALL PLASTIC INSULATED CABLES, ANNUNCIATOR WIRES, PLASTIC CORDS, AND MANY OTHER PRODUCTS WHICH WOULD ORDINARILY REQUIRE THE USE OF MUCH MORE EXPENSIVE PROCESSING EQUIPMENT.

GENERAL SPECIFICATIONS

CONSTRUCTION: STEEL, HIGH STRENGTH ALLOYS AND BALL BEARING THROUGHOUT. MECHANISM HOUSED IN RIGID STEEL FRAME WITH SAFETY DOOR OPENING MACHINE SHUT-OFF.

NO INSTALLATION WORK REQUIRED.

STANDARD STEEL REELS: No. 7—16" x 8", 250 LB. CU. CAPACITY
No. 9—22" x 11", 650 LB. CU. CAPACITY
No. 10—24" x 14", 1000 LB. CU. CAPACITY

AVAILABLE LAYS: FROM 1/8" TO 4 7/8". RIGHT AND LEFT HAND TWIST. LAYS ARE FIXED AS SET. NO LAY WANDERING.

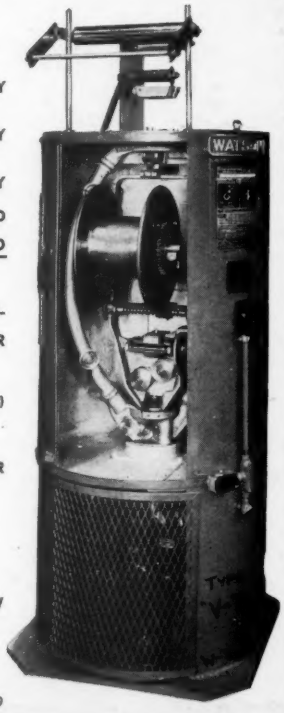
ELECTRICALS: MOTORS, CONTROLS AND LOW VOLTAGE ELECTRIC STOPS ARE BUILT IN AND WIRED FOR OPERATION.

STRAND SIZE RANGE: FROM FINE (7 x #34 B. & S.) TO 5/16" DIAMETER STRANDS.

WIRE FEED POINTS: FROM FRONT, REAR OR EITHER SIDE.

DELIVERIES: FROM STOCK.

SHIPMENTS: DOMESTIC—F.O.B. PATERSON, N. J.
FOREIGN—BOXED & DELIVERED TO NEW YORK HARBOR.



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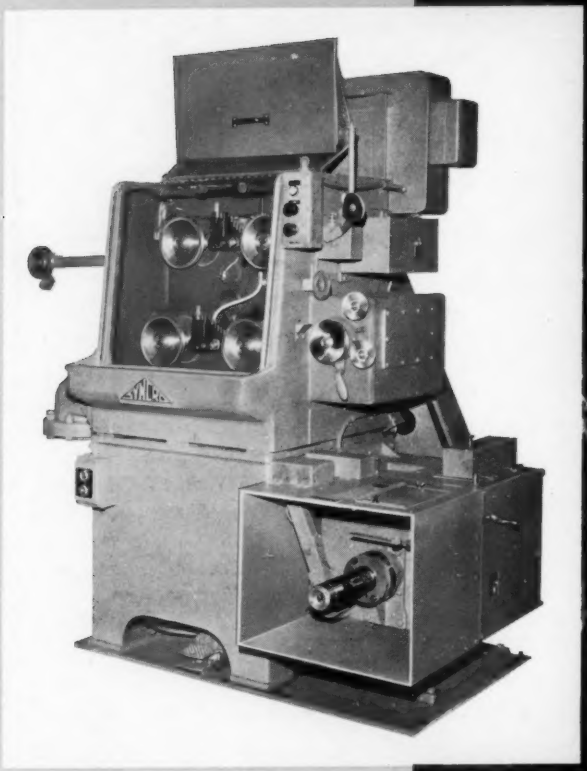
MACHINE BULLETINS AND PRICES UPON REQUEST

7-59

new... 6000 F.P.M. ...wire drawing machine



Model BG-16 . . . A new measure of Syncro Machine Company's superior design. BG-16 is a 25-horsepower non-ferrous wire drawing machine offering a finished range of copper wire sizes from 19 to 34 B&S gauge, and operating speeds up to 6000 F.P.M. This machine can be supplied with a standard 100 pound capacity model B Spooler (as shown) or larger spoolers to meet specific production requirements. Improved die holders with new reciprocating mechanisms are individually piped to receive solution from the main source of supply. In addition to high speed and heavier capacity, the new all-gear-drive unit incorporates an externally-mounted force-feed lubrication pump with a safety interlock. This pace setting machine serves as another reason why—when drawing wire—it pays to specify Syncro.

THE MEASURE OF SUPERIOR DESIGN

THE MARK OF QUALITY

SYNCRO

SYNCRO MACHINE COMPA

Perth Amboy, New Jersey, U.S.A.

affiliated company: WINGET SYNCRO Ltd. Rochester, Kent, Englan

Better Machinery for the Wire Industry

WIRE DRAWING MACHINES • STRANDERS • CONTINUOUS ELECTRIC ANNEALERS • PAYOFFS • CAPSTANS • WIRE INSULATORS • HEAVY DUTY TAKEUPS • TAPERS • SPECIAL M